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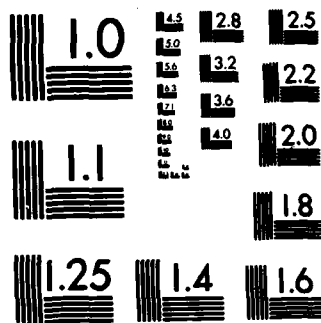
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ESN 38-8

August 1984



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**EUROPEAN SCIENTIFIC NOTES
OFFICE OF NAVAL RESEARCH
LONDON**

Commanding Officer CAPT M.A. Howard, USN
Scientific Director James W. Daniel
Editor Larry E. Shaffer

August 1984
Volume 38
Number 8

**BEHAVIORAL
SCIENCES**

Experimental Social Psychology in Europe Richard E. Snow 415

A conference of the European Association of Experimental Social Psychology focused on individual and social behavior; group processes and leadership; development of social behavior; social psychology and economics; social identity and intergroup relations; mood, emotion, and affect; and social cognition.

Personality Psychology in Europe Richard E. Snow 417

A conference of the European Association of Personality Psychology dealt with issues such as the following: person-situation interaction and process analysis, social construction of personality, and subliminal perception.

**BIOLOGICAL
SCIENCES**

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Microwave-Induced Hyperthermic Effects Thomas C. Rozzell 420

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- Research in Programming Languages at the
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Coming in October ... ESN Mailing List Update

ONR, London, is updating its mailing list for the distribution of *ESN* to individuals. With the October issue you will receive a readership-response form to be returned to ONR, London.

Individual addressees who do not reply will be dropped automatically from the mailing list.

ESN Invites Letters to the Editor

ESN publishes selected letters related to developments and policy in science and technology in Europe and the Middle East or to interactions between the US and Europe and the Middle East in science and technology.

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Not all letters can be used; letters may be edited for reasons of space and clarity.

BEHAVIORAL SCIENCES

EXPERIMENTAL SOCIAL PSYCHOLOGY IN EUROPE

by Richard E. Snow. Dr. Snow is the Liaison Scientist for Psychology in Europe and the Middle East for the Office of Naval Research's London Branch Office. He is on leave until September 1985 from Stanford University, where he is Professor of Education and Psychology.

The Office of Naval Research, London, was honored at a conference of the European Association of Experimental Social Psychology, held at Tilburg University, The Netherlands, 8 through 12 May 1984. To celebrate the 20th anniversary of the association, the conference organizers invited John Lanzetta of the University of Delaware to give a retrospective review of the association's history. It was a surprise to this reporter, as it was to much of the membership present, to learn that the association stems significantly from Lanzetta's efforts while serving as liaison scientist for psychology at ONR, London, in 1962. Albert Pepitone, another prominent US experimental social psychologist, was also present. In Lanzetta's presentation and also in Pepitone's discussion, it was clear that Luigi Petrullo also aided the development from his post in the Psychological Sciences Division at ONR Headquarters in Arlington, Virginia. Many younger Europeans thus learned about an ONR function they had not known about, or understood, and some were incredulous to learn that a US military organization did, and still does, support the development of basic science in Europe as well as in the US.

Background

The history of the association deserves a brief recount both because such history is easily lost and because the field's pattern in the 1960s is clearly similar to that of some other fields of psychological research in Europe in the 1980s--this reporter has been engaged in recent months in helping organize what hopefully will become a European Association of Instructional Psychology, or some such, precisely because the pattern is similar.

Lanzetta said he was the third liaison scientist in psychology at ONR, London, following Alphonse Chapanis in engineering psychology and Lee Cronbach in personnel, training, and psychometric

psychology. As the first social psychologist, he tried to contact his European counterparts. The going proved difficult, because each European researcher seemed connected only to US work and not to other counterparts in Europe. Lanzetta had to correspond with US friends, including Petrullo and Pepitone, to help identify each new European researcher in turn. He found himself the hub of a wheel with many spokes but no rim. The committee he then organized and chaired produced that missing rim--a permanent association among Europeans.

Experimental social psychology is now alive and well in Europe. The association's membership numbers close to 250, including persons from virtually all countries in Europe, both East and West. It publishes a journal, *The European Journal of Social Psychology*. There were 109 presentations at the Tilburg Conference. Furthermore, the concept of such an association and periodic conference has spread to other domains. There is now a European Association of Personality Psychology (see following article); and, as noted above, the idea for a European Association of Instructional Psychology is now forming. Thus Lanzetta's efforts, and the liaison science function generally, have had multiplicative effects--and the science of psychology has benefited.

The Tilburg Conference

The Tilburg Conference contained many valuable presentations. With five concurrent symposia and paper sessions extending over 3 days and invited speeches each evening, far more information came forth than can be summarized here. This article relays only a few highlights. A more complete report, combining the details of this conference with those of the following conference on personality psychology in Europe (see page 417) will be available from ONR, London, later this year; interested readers should write to be placed on the mailing list for that report.

The seven main themes of the conference are described below.

Explanation and Attribution of Individual and Social Behavior. Human beings do not ordinarily use scientific reasoning in reaching inferences, judgments, and beliefs in everyday life. It is thus assumed that most everyday reasoning is full of error when compared with scientific criteria. Attempts to alter this state of affairs, such as the routine teaching of statistical inference in public school (as is now done in

Japan), are not likely to have substantial impact. We need first an understanding of "lay-epistemology." There is growing evidence, for example, that psychological factors that bias inferences away from accepted criteria need not increase the probability of error--people do not, just because of reliance on subnormative heuristics, necessarily underutilize statistical information in their personal and social judgments. Rather, they seem unlikely to use any information that appears nonsalient or irrelevant to the subject at hand. But their beliefs can be altered by manipulating the motivational conditions for reasoning rather than the cognitive conditions only. Furthermore, much social psychological research on this process appears to be both ethnocentric and chronocentric. To understand how people perceive and interpret social incidents and interactions, a more transhistorical and transcultural viewpoint is needed. Even the scientist's choice of scientific problems to study can be shown to depend significantly on local personal and socio-cognitive factors rather than on scientific criteria alone. And the process and product of theory construction also display the personal strategies of human scientists. The expansion of experimental social psychology in these directions badly needs paradigm enrichment through broader use of the matrix of methodologies provided by its sister disciplines of sociology, anthropology, and social work, in addition to other branches of psychology.

Group Processes and Leadership. To understand how characteristics of persons and of situations influence patterns of action in new social environments, a combination of concepts from the person-situation interaction perspective of ecological psychology and from "Handlungs Psychologie" (the psychology of action) is required. The time-course of adaptation to such environments can be traced using diary, questionnaire, and videotape records analyzed from this combined perspective. The emergence of leadership can also be studied. There is evidence that the decisive factor in group polarization, attitude formation, and consensus formation is not in the amount of group interaction so much as it is in the emerging normative strategy of a group leader--democratic leadership seems to produce the longest times in reaching decisions, whereas "*laissez-faire*" leadership depresses group polarization relative to both autocratic and democratic situations. Polarization can be

expected to be highest in leaderless groups. There are also complex interactions determining subordinate perceptions of fair treatment under different conditions of leader-subordinate relationships.

Development of Social Behavior. It is possible to promote children's understanding of verbal referential communication and of the causes of communication failure. Treating children as though they understand the causes of such failure appears to be sufficient to develop the understanding that what is said is not always the same as what is meant--perception is inferential. It appears possible to synthesize developmental social psychology with developmental psycholinguistics for the benefit of both fields. Until recently, each field has used rather simplistic models of the phenomena of central interest to the other. There has also been little study of the nature of peer relations among children and their effects on communication, friendship formation, aggression, and related social phenomena. Biological perspectives on sex differences and the role of parental identification are also relevant to the study of early social behavior.

Social Psychology and Economics. Experiments on how people use principles of equality, equity, and self-interest suggest that an equality dimension rather than a self-interest dimension accounts for most variance in allocation decisions when pairs of persons are asked to reach agreements. Different principles seem not to be used in the allocation of goods versus benefits. In all exchange theories, however, there has been insufficient attention paid to the definition of inputs and outcomes for each person; many aspects of decision situations can be perceived and evaluated in either way by different persons. Such theories are improved by distinguishing these perceptions and the degree to which they are moderated by comparisons with other persons' perceived inputs and outcomes. Social psychological research is now being applied to the promotion of energy-saving behavior, the resolution of marital conflict, and analyses of pay comparisons and pay satisfaction in industry.

Social Identity and Intergroup Relations. It has often been found that dividing subjects into two distinct social groups, even on trivial criteria, leads to intergroup discrimination. A motivational explanation emphasizes the need for positive social identity which

leads subjects to overvalue their own group's performance. A cognitive explanation argues that mere perception of two distinct categories produces accentuation of one's own group at the expense of the other. If two dichotomous categorizations are crossed, however, the cognitive theory predicts that intergroup discrimination will be canceled out, whereas the motivational theory predicts even sharper intergroup discrimination. The weight of new evidence from laboratory studies now supports the cognitive view. But such experiments ignore the history and social complexity of real intergroup relations. In the real world, intergroup discrimination depends on the minority versus majority status of each group, the perception of the rigidity versus flexibility of the style adopted by each group's members, and the degree to which the behavior in question is public versus private. Evidence is also available to show that group differentiation (i.e., the duration of a group's existence and its uniqueness with respect to other groups) influences at least two other aspects of individual behavior in relation to group performance: the degree to which group members identify with their group, and the degree to which they participate or withdraw from group interaction.

Mood, Emotion, and Affect. Recent work in US cognitive psychology suggests that temporary mood states influence memory and related information processing. New evidence in Europe suggests strong mood-dependency effects on behavioral assessments of others and on recall memory for social interactions. Time perspective also seems important in mood; recalling a past negative event results in more positive reports of present well-being than does recalling positive past events. Recalling present-time life events, however, leads to reports of present well-being depending on the hedonic quality of that event. These and other data seem to favor a "mood as information" hypothesis over the "mood congruent availability" hypothesis prominent in US work. Other results suggest correspondence between semantic affective dimensions and facial expressions of emotion.

Social Cognition. Negative interpersonal evaluations appear to have greater information value, for both sender and recipient, than do positive evaluations. There is evidence also that affective cognitions of other persons and events, whether positive or negative, have high evaluative consistency that facilitates decision making

in time-pressed and affectively loaded situations. Despite the simplification and bias that such cognitions bring to decisions, they may be adaptive for individuals in coping with stressful events. These affective cognitions should be distinguished from the descriptive cognitions involved in acquiring information and multiplying points of view. Both modes of information processing are functional depending on situational demands.

Other symposia were devoted to social motivation, attitudes, education and social psychology, health and social behavior, structural analysis of social behavior, and the teaching of social psychology. An overview of recent work in European social psychology can also be gotten from Doise and Moscovici (1984). Chapters reflect research on many of the same topics by many of the authors at the conference.

Reference

Doise, W., and S. Moscovici, eds., *Current Issues in European Social Psychology* (Cambridge: Cambridge University Press, 1984).

5/23/84

PERSONALITY PSYCHOLOGY IN EUROPE

by Richard E. Snow.

The preceding article recounts how the European Association of Experimental Social Psychology grew from efforts by the Office of Naval Research, London, in the early 1960s and in turn spawned another, similar organization. That organization, the European Association of Personality Psychology, began with a conference held at Tilburg University, The Netherlands, in 1982. Selected conference proceedings have now been published (see Bonarius, Van Heck, and Smid, 1984). The second conference, formally founding the association, took place at the University of Bielefeld, Federal Republic of Germany, from 16 through 19 May 1984; selections from its proceedings will appear as a book from the same publisher, probably in 1986. There were 113 presentations delivered at this second conference, approximately 150 members attended, and the association membership is estimated at above 200, representing most countries in both East and West Europe.

The Bielefeld meeting contained four symposia plus three parallel paper sessions through 3½ days, with four invited speakers and some poster sessions. As with the experimental social psychology conference, only some highlights can be reported here. A combined report on both conferences will be available from ONR, London, later this year.

Some main themes, and a collection of various reported findings, are described below.

Person-Situation Interaction and Process Analysis

Personality research has shifted in recent years from a purely trait-oriented approach to a person-situation interactional and process-oriented view, involving experimental studies of intrinsic and extrinsic motivation, achievement-related behavior, learned helplessness, complex problem solving, and affiliative behavior. Molar versus molecular, cognitive versus dynamic, and nomothetic versus idiographic theoretical perspectives are also represented. In particular, there is now a return to early European and US views of the importance of idiographic research. New methodological developments not available to early theorists with an idiographic bent make such research possible today. Personality research in Europe is thus diverse. An integration of this diversity must center on process, but it is not yet clear how this is best accomplished.

It does seem clear that individuals respond to personality questionnaires under the influence of a variety of transient as well as more permanent personality states. The same quantitative score on such a questionnaire may be arrived at by many different routes. It is thus absurd to consider such total scores as reflecting unitary traits without analysis of underlying response tendencies and processes related to such measures and the situations in which they are administered. Both cognitive and motivational aspects are involved.

Motivation and cognition can indeed be seen as aspects of the same fundamental process. An experiment in intrinsically motivated problem solving illustrates the close connection between structural and dynamic aspects of behavior. Schema theory seems to bring these aspects together in a single model.

There are contrasts and situation specificities, however. For example, the self-image bias in person-perception research can be understood as defensive or cognitive. Evidence supports the

defensive model in that even small situational changes in self-perceptions produce changes in how individuals process information about others.

As another example, assertiveness seems clearly to be determined by an interaction of person and situation variables. Evidence suggests that subjects showing high defense and high need for approval behave less assertively toward peers than toward others of higher or lower status than peers, whereas subjects with high defense but low need for approval behave in the opposite way.

To take still another example, decision styles, analogous to cognitive styles, have been distinguished to identify decision makers differing on desire for versus avoidance of decisions, difficulty versus ease of decisions, rigidity versus elasticity of decisions, probabilistic versus deterministic attitude toward events, immediate attainment versus postponement of the effect of decisions, orientation toward persons versus things, and execution versus nonexecution of decisions. But some decision makers appear to be more situation-dependent, while others appear situation-independent. Such styles have often been studied as traits in the management sciences, while the most recent psychological research seems to emphasize situation-specific decision making. Recent reviews of both literatures indicate that: comparable studies often have contradictory results; variance attributable to cognitive styles is often low; the prediction of decision behavior from personality characteristics is often unsuccessful; the search for pervasive decision styles is misplaced--the evidence favors person-situation interaction or pure situationism as the determiner of decision behavior.

Finally, Mischel has proposed that "powerful" situations lead all subjects to behave in similar ways, whereas "weak" situations allow display of individual differences. But attempts to operationalize an index of situational power seem to fail; none of eight situational elements proposed correlate with a power index based on Mischel's hypothesis.

Studies of Particular Constructs

1. Anxiety can be divided into cognitive elements (e.g., worry) and emotional elements (e.g., perception of physiological activity, tension). But further division is also justified by the evidence; social anxiety (e.g., shyness, embarrassment, shame) is distinguishable from test anxiety, and the

latter can be general or connected to specific activities (e.g., sports, mathematics). There are also metacognitive controls that operate differently in public versus private situations. Current evidence suggests that the "worry" scale does not function in Europe (though it does in the US) and that multiple causal chains operate among anxiety factors such as bodily reactions, tension, irrelevant thinking, escape cognitions, self-concern, anticipation of failure, and worry about coping adequacy.

2. Risk-takers in gambling situations show higher scores on stimulation seeking, whereas risk-avoiders show opposite temperamental characteristics. Stimulation seeking and disinhibition are both aspects of the sensation-seeking dimension related to behavioral and physiological measures.

3. Disparity between a weak need for stimulation and a strong need for achievement imposed by social demands (of family or school) may be manifested in Type-A behavior patterns among adolescents. Type-A behavior is a risk condition for coronary disease and can be identified in videotapes of body movement during a stressful calculation task; several indices of movement distinguish Type-A from Type-B individuals.

4. Nicotine produces an increase in vigilance among extroverts as compared to introverts. But the expectation of nicotine (when a placebo is actually administered) has the same effect for extroverts and also a vigilance-depressing effect for introverts. Thus, latent knowledge influences response to nicotine in different personality types.

5. Average evoked potential and electrodermal response measures appear to reflect attention differences, interference and habituation processes, and certain aspects of individual differences in timidity when collected in association with the Stroop Color-Word Interference Test. Measures of average evoked potential and choice reaction time have also been proposed as culture-free tests of intelligence. Cross-cultural data using these measures question this assertion and point to interpretations of group differences based on response strategy and arousal rather than intelligence as traditionally defined.

6. Intelligence test profiles relate to personality differences in ways corresponding to theory. In particular, subjects differing on extraversion-introversion show markedly different scores on the Wechsler Adult Intelligence Scale, with introverts higher on

verbal scales. Relations with the psychoticism and lie scales of the Eysenck Personality Inventory also suggest that intelligence-profile differences might serve as performance measures of personality. In turn, these relations tie into psychophysiological theories of intelligence and personality.

7. Shyness seems to be a complex involving lack of social self-esteem, fear of negative evaluation, need for social contact, and a lack of social contact and social interest.

8. Occupational stress and adjustment to work among seamen after training can be predicted from personality measures collected before training. About 38 percent of the criterion variance is accounted for by regression equations emphasizing self-esteem, resistance to stress, satisfaction of sexual and social needs, need for recognition, and intelligence.

9. Psychopaths and sadists seem to display an intrinsic motivation toward aggression. There may be an intrinsic aggressive need which has become autonomous of other motivations, or more complex cognitive mechanisms related to specific norms.

10. Individual differences have not been a major concern in "Handlungs" (action) theory. But it is possible to examine such differences, for example, in planning behavior. Accuracy, speed, and flexibility of planning have been found to be the largest sources of variance among individuals.

11. Contrary to some recently stated views, "explicit" scientific theories and the "implicit" theories of lay persons can be quite similar. This has been demonstrated for theories of alcoholism, delinquency, and neuroticism. But age, sex, and voting preferences of lay persons relate to the type of implicit theory held; there are demographic and belief differences associated with preference for different implicit theories.

Social Construction of Personality

The social constructivist view of personality provides a radical alternative to most of the above approaches. It emphasizes the shared categories of social behavior understood by actors and observers. Personality-trait names, in this view, are merely convenient ways of summarizing and communicating this shared meaning. The implications of this view suggest many interesting experiments, but also pose difficult theoretical problems because personality seems to end up in the air between two human beings rather than in the head of either.

Subliminal Perception

Another alternative approach identifies subliminal perception as the key to understanding personality. Preconscious and unconscious processing display themselves in both psychophysiological and personality measures. The implications of recent results in this field are profound for personality theory. It is clear, however, that perceptual, physiological, biochemical, and neuropsychological measurement related to this domain is exploratory in the extreme. With demonstrated practical correlates of some of these measures now in hand, however, this becomes a ripe field for more penetrating basic work. There are clearly marked individual differences in sensitivity to, and ways of handling, stimuli below the conscious threshold. There appear to be determinants of personality with origins in preconscious processes, and the makeup and modification of personality may be understood by research on stimulus presentation below this threshold.

As one example, cognitive theories of anxiety suggest that changes in attention control account for disruption of performance in anxious persons. But psychophysiological evidence suggests that, especially in the early stages of coping with a performance task, subjects are unaware of anxiety or expectancies that later produce disruption; there may be important subliminal prestages not yet considered by cognitive theories.

Reference

Bonarius, H., G. Van Heck, and N. Smid, eds., *Personality Psychology in Europe: Theoretical and Empirical Developments* (Lisse, The Netherlands: Swets and Zeitlinger, 1984).

5/25/84

BIOLOGICAL SCIENCES

FRENCH USE FLUORESCENCE POLARIZATION TO MEASURE MICROWAVE-INDUCED HYPERTHERMIC EFFECTS

by Thomas C. Rozzell. Dr. Rozzell is the Liaison Scientist for Biological Sciences in Europe and the Middle East for the Office of Naval Research's London Branch Office. He is on reassignment until August 1985 from the Office of Naval Research, Arlington, VA, where he is Program Manager for Cellular Biosystems.

During the past few years there has been an increase in the use of electromagnetic (microwave and radio-frequency) energy to treat cancer by the induction of hyperthermia in the tumor. Occasionally, hyperthermia is used alone in cancer therapy, but the most general use is in combination with chemotherapy or radiation therapy. Not all tumors are amenable to hyperthermia treatment, and the success rate varies considerably. In general, though, fairly localized, well-defined tumors with a good blood supply respond best.

In treatment with hyperthermia, it has been found that the temperature of the tumor tissue must be raised to a level of approximately $42.5 \pm 0.5^\circ\text{C}$ in order to significantly reduce the tissue's resistance to drugs or radiation. One reason that electromagnetic energy (EME) has been used to induce the hyperthermia is that it can be directed to the tumor target with minimal heating of surrounding normal tissue, especially tissue lying between the tumor and the surface of the body. In cases where hyperthermia alone is used to kill the cells, it has been found that, at a given temperature level, EME is more effective than other methods, such as infrared or hot water. The cause of this EME specificity remains a mystery, though there is much speculation about changes in membrane permeability, cellular metabolism, and the like.

One attempt to solve this mystery has been made by Drs. M. Dardalhon and D. Averbeck (Institut Curie, Paris) and Drs. C. Moré and A.J. Bertheaud (Centre National de Recherche Scientifique [CNRS], Paris). In what appears to be the final research project in bioelectromagnetics sponsored by the French government, this team has studied the effect of 2.45-GHz microwaves on mammalian cells using fibroblasts of a Chinese hamster lung tumor (V79 cells).

More than one cellular target, including cytoplasmic organelles and membranes, is likely involved in hyperthermia-induced cell death. Therefore, the Institute Curie-CNRS team decided to investigate changes in the degree of fluorescence polarization related to changes in the microviscosity of the cytoplasm and mitochondria, as well as changes in enzymatic hydrolysis and cell permeation of an intracellular fluorescent marker using the method of Cercek and Cercek (1972). The method is based on polarized light excitation of fluorescein molecules following their production in the cytoplasm by enzymatic hydrolysis of nonfluorescent fluorescein diacetate (FDA). The preferential excitation of the fluorescein molecules

serves as a probe for the physical state of the cytoplasmic organization. The fluorescence as well as the kinetics of enzymatic hydrolysis were determined by an automatic and computer-controlled spectrofluorimeter specially designed by Moré and Berteaud (1982).

Dardalhon and her colleagues compared the results obtained with the fluorescence polarization technique with those obtained on cell viability measured by the method of trypan blue exclusion and those obtained on cell survival, i.e., on the colony-forming ability of the cells. For comparison with classical hyperthermia and to determine whether observed changes were due to specific microwave responses, they used a high-precision ($\pm 0.05^\circ\text{C}$) thermostated waterbath. A microcomputer controlled the precise kinetics of the rise in temperature and reproduction of the temperature profiles obtained with microwaves.

Using microwaves at 2.45-GHz at power densities from 125 to 200 mW/cm² and 30-minute treatment times, the researchers were able to show that at temperatures below 40°C there were no significant changes in the degree of polarization of the emitted fluorescence. However, a slight stimulation was seen in FDA's enzymatic hydrolysis, which increased at higher power densities. When the cells were treated at temperatures above 42°C and for exposure times of 35 minutes, the degree of polarization increased markedly, whereas the enzymatic hydrolysis of FDA decreased rapidly, possibly due to changes in cellular enzymes, or membranes, or both. It was postulated that these changes were likely of thermic origin, since they disappeared if the cells were cooled during microwave exposure. The microwave-induced hyperthermia also produced cellular lesions that were relatively stable and not easily reversible. That is to say, the observed changes in polarization do not depend on the time interval between the microwave treatment and the measurement of fluorescence polarization, at least for time intervals up to 90 minutes.

At temperatures below 40°C the response of samples treated by the waterbath were similar to those treated by microwaves, except that the slight stimulation of enzymatic hydrolysis of FDA appeared to be absent. At temperatures above 40°C, the response of the samples treated by the waterbath was less than those treated by the microwave energy. This may have been due to the fact that the amount of thermal energy absorbed by the two techniques is somewhat different, even though the measured

temperatures are the same. The waterbath samples had no loss of heat to the environment, whereas the microwave-treated ones were able to diffuse part of their energy. This is a characteristic problem in such an experiment. As yet there is no way to exactly mimic, and thus accurately compare, heat input due to EME.

When the researchers analyzed the results as a function of specific absorption rate and corrected for heat loss, it was evident that the observed changes in the degree of polarization and in enzymatic hydrolysis were very much comparable in the two parts of the study.

The research team measured the capacity of the cells to exclude trypan blue in an effort to determine if the observed changes were related to cell viability (i.e., the colony-forming ability of the cells). They found a close relationship between the decrease in enzymatic hydrolysis and the capacity of the cells to exclude trypan blue. This finding would seem to indicate that changes occur in the cell membrane and are accompanied by changes in FDA hydrolysis. The membrane-permeability changes were examined by measuring the fraction of fluorescein that left the cytoplasm and went into the solution. Permeation of fluorescein was shown to increase when cells received an absorbed energy of about 100 J/g, corresponding to a temperature of 48°C. This increase occurred sooner after microwave treatments than after treatments with the waterbath.

Cell survival was slightly lower in cultures exposed to microwaves as opposed to those that were given hyperthermia with the waterbath. The changes in cell survival were seen at slightly shorter treatment times and at slightly lower final temperatures than the changes in the degree of polarization and in enzymatic hydrolysis.

These studies by Dardalhon and coworkers suggest that the microwave energy acts on enzymes, or membranes, or both. The notion that membranes are affected is also supported by the close correlation between the decrease in enzymatic hydrolysis and the decrease in cell viability.

The French government has decided to halt support of this type of fundamental research. The rationale for the decision will be discussed in an ONR, London, report being published this year. This project is just one of a number in bioelectromagnetics that have been carried out in the country over the past two decades. However, as in other areas, priorities change, and for the

time being, such research projects are not among the chosen few. This is unfortunate because the project is a good example of one providing spinoffs into other areas. There is little doubt that the techniques used here will provide additional knowledge about intracellular mechanisms and intracellular membrane function, both of which are important in several areas of research conducted and supported by the US Navy. The CNRS laboratory headed by Dr. A.J. Berteaud (actually located in Thiais, a suburb of Paris) was the backbone laboratory for physical measurements and instrumentation. With loss of EME funding, Dr. Berteaud will direct the talents of his group in other directions.

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5/15/84

COMPUTER SCIENCES

LOCAL-AREA NETWORK RESEARCH AT CAMBRIDGE UNIVERSITY

by J.F. Blackburn. Dr. Blackburn is the Liaison Scientist for Computer Science in Europe and the Middle East for the Office of Naval Research's London Branch Office. He is on leave until September 1984 from the National Academy of Sciences, where he is Executive Director, Computer Science Board.

The Cambridge ring is well established as a local-area network in many universities throughout the UK. The Cambridge fast ring is a high-speed local-area network similar to the Cambridge ring but much faster. And in addition to allowing much higher transfer rates than existing networks, it incorporates facilities for partitioning the bandwidth between several groups of users and for connecting rings together without the need for bridge computers

and complex addressing schemes. The Cambridge fast ring is currently being implemented in very large scale integrated circuits (VLSI).

Local-area networks currently in use in research establishments, universities, and industry offer communication transfer rates on the order of 1 megabyte per second (MB/s) and allow the interconnection of several hundred devices. Faster networks are needed to allow the connection of more and faster devices to accommodate more and different applications, such as the transmission of facsimile and video images.

A wide variety of devices of different speeds need to be able to use the fast network simultaneously and without interfering with each other. For example, digital TV signals require a constant bandwidth of about 10 MB/s; and computer peripherals require a similar rate, but only intermittently. On the other hand, digital telephones require only 64 kilobytes per second (KB/s) but have an upper bound on the service time of their transmissions. The network should be easy to interface to a wide variety of devices and should provide facilities to make protocols simple and efficient. Error checking at the network level is important to ensure high reliability. The cost of connecting a device should be low to allow use of inexpensive devices.

For the fast Cambridge ring, a raw data rate of 100 MB/s was chosen as a target, and the design was required to be realizable in VLSI. Also, fiber-optic connections were to be usable. The slotted ring was chosen as a suitable framework for the design of the fast network.

Architecture

The ring consists of stations, which transfer data between devices connected to the ring; monitors, one of which is required on each ring to initialize and maintain the slot structure; and bridges, which copy minipackets between rings. The nodes are connected in a ring by coaxial or fiber-optic cable, and the rings may then be connected by bridges in a back-to-back configuration. A number of slots (minipackets) circulate around the ring in a train and are contained in the cable delay and stations.

Two types of slots, normal and channel, are allowed; they are distinguished by a bit near the front of the slot. Once a normal slot is returned to its source after transmission, it must be passed on empty. Channel slots may be refilled by the source on return and thus provide a higher data rate,

independent of other traffic on the ring. A ring can be configured to have up to 15 slots of each type.

The addressing scheme provides for 16-bit global addresses which are unstructured and yet support any configuration of rings connected by bridges. Bridges operate at the minipacket level and contain a 64-KB routing table, which enables them to receive minipackets destined for devices not on the ring on which they are transmitted. The ring has a 16-bit register, augmented by a 64-KB map which determines whether minipackets should be received from any address, no address, or one particular address.

The ability to join rings by bridges helps make the network tolerant of hardware failures. The network may provide several physical routes between devices, though only one logical route is used at any one time. To monitor the performance of individual links, a station detecting an error generates a fault minipacket; thus the fault can be localized to a single link.

The current aim of the designers is to place the station logic and all buffers on a semicustom complementary metal-oxide semiconductor (CMOS) chip, with an emitter coupled logic (ECL) uncommitted logic array being used for the high-speed parts of the logic. The CMOS also duplicates this logic and will thus work at slow speeds (up to 10 MHz) without the ECL part.

The CMOS chip will function as a station, a bridge, or a monitor by applying the appropriate level to a pin. A 64-KB random-access-memory chip implements the select map at stations and the routing table at bridges. The CMOS chip has a simple bus interface which allows a wide variety of devices to be attached. The ECL and CMOS chips have limited line-driving capabilities, and extra circuitry will be required for very long links or for fiber-optic links.

Transmission and Reception

The station contains two 32-byte data-transmission buffers and two destination address buffers. Transmission begins when a data buffer becomes full or when a transmission command is received. The station waits for an empty slot to arrive, marks it full, and places the destination address, its own (source) address, and the data buffer into the appropriate fields of the minipacket. The cyclic redundancy check (CRC) is also computed and inserted at this point, and the minipacket travels around the ring in search of its destination.

The minipacket is received by the destination itself or by a bridge if the destination is not on the ring. If the

receiver is busy or detects a CRC error in the minipacket, the response bit is marked and the minipacket returns to its source. If the minipacket is accepted or rejected with retry pointless, the response bit is not marked. When the minipacket reaches its source, it will be retransmitted a number of times according to an algorithm if the response bit was marked.

If the minipacket was accepted and the second transmit buffer was filled, then another transmission commences. If the slot was a channel-mode slot and the second buffer was full when the slot returned, then the slot is replenished from that buffer and goes on to its destination. In this channel mode, the response bit from the previous transmission can only be seen after the slot is replenished. To keep the sequencing of minipackets correct, the response is left intact and goes on to the destination, where it inhibits reception of the new minipacket. When the slot returns again, it is marked empty and channel mode is abandoned. Thus both modes appear identical to the attached device, although channel mode provides higher data rates.

For reception at a station, one of its two buffers must be free, the select register and map must agree to the reception, and the CRC must be correct. The response list is marked "try again" if any of these conditions are not met. At a bridge there is no select register or map, and reception is on the basis of finding the destination address of the minipacket in the bridge's routing table.

The Cambridge fast ring is a versatile network based on interconnected rings. A global addressing scheme allows the basic unit of transmission, the minipacket, to traverse rings easily. The network provides very high guaranteed data rates for devices which can use them, and yet imposes no constraints on the speed of devices which may be attached. A wide variety of traffic types may coexist on the network, ranging from voice through computer communications to video. A versatile hardware implementation is under way which will provide a number of cost and performance options and which makes connection to the network simple and inexpensive.

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4/30/84

NATURAL-LANGUAGE RESEARCH AT CAMBRIDGE UNIVERSITY

by J.F. Blackburn.

Research in natural language at Cambridge includes using a natural-language front end to databases with evaluative feedback, driving a database front end using general semantic information, summarizing English texts automatically, and accumulating and applying context in text processing.

A Natural-Language Front End to Databases

This system was designed to promote portability and to facilitate interactive natural-language feedback with the user. The convenience of natural language and the freedom of expression it allows have provided the rationale for active research in the design and construction of natural-language interfaces to database systems. Some researchers (e.g., Shneiderman, 1978) have concluded that natural language possesses some undesirable properties as a medium for communication with structured formal objects, and argue that a formal language is better suited to this purpose. The researchers at Cambridge believe that the real case for natural-language interfaces to databases is not their use as passive programs, limited to operational responses to individual commands, but their use as cooperative agents engaged in active dialogue with the user.

The system being developed at Cambridge is characterized by modular design, extensive use of general semantics, exploitation of natural language for system construction as well as system use, and use of natural language for questioning and feedback.

The natural language analyzer uses a general syntactic grammar of English, and semantic processing of the input is motivated by the general semantics of ordinary language, depending entirely on the specifics of the database domain. To reconcile the user's view of the information stored in the database with the actual administrative structure of the formatted data within the framework of a transportable system, a database management system (DBMS)-independent abstraction of the input is done. This is then translated against the database schema to derive the actual DBMS search query. Since the front end is being moved to different domains or DBMS environments, a new lexicon, a new schema, and (possibly) a new low-level query language have to be acquired.

These problems are solved by identifying the different types of knowledge required in the process of interpreting a natural-language question to derive a search query, separating domain-independent from domain-dependent knowledge, and separating domain knowledge from database administrative knowledge, in all stages of processing. Transportability is further enhanced by keeping the central, linking, domain-specific knowledge in declarative form. Initial linguistic processing is carried out by a non-domain-dependent semantic analyzer. This produces explicit and normalized semantically based meaning representations for questions. The representations are more convenient input to the database task-, domain-, and implementation-oriented operations required to construct actual search specifications than are the texts of the raw questions texts. These operations interpret a formal query against three declarative knowledge bases: information about the domain, information about the administrative structure of the database, and information about the syntax and semantics of the target low-level search query language.

The front-end processing is in two stages: analysis of the English question followed by translation of the resulting representation into target query language for searching. The analysis component has analyzer and extractor modules which use linguistic and logical knowledge respectively to construct a meaning representation of the input question and to extract from it a formal query in logical form. The language generator works from the initial unambiguous meaning representation and offers paraphrases of the input back to the user.

In the second stage of processing, the translator module interprets the semantic content of the logic representation with reference to the segment or variant of the real world modeled by the database. It essentially substitutes high-level data language expressions within the logic representation framework. Its output query representation is then passed over to the converter to obtain a generalized algebra expression, from which the target search representation is derived. This may be regarded as a low-level data (or query) language expression, appropriate to the implementation DBMS, which may be reinterpreted in English for final validation by the search query reformulator. It will then be presented to the DBMS for execution.

Automatic Summarizing of English Texts

A program called SCRABBLE, which can summarize short English texts, has

been developed. It uses large bodies of predictions about the likely contents of texts on particular topics to identify the commonplace material in the input. Prespecified summary templates, each associated with a different topic, are used to condense the commonplace material in the input. Filled-in summary templates are then used to form a framework into which the unexpected material in the input may be fitted. This allows unexpected material to appear in output summary texts in an essentially unreduced form. The summaries are in English.

The program is based on technology similar to a script applier. However, it is much less likely to produce misleading summaries of an input text than some previous systems, and can operate with less information about the subject domain.

The system uses three main new ideas.

1. It incorporates a new method for identifying the topic of an input text.
2. It allows a section of text to have more than one topic at a time, or at least a composite topic which may best be dealt with by the computer program simultaneously applying to the text predictions associated with more than one simple topic.
3. It incorporates new mechanisms for including in its output summary texts unexpected material in the input. This unexpected material may be the most salient matter in the input text.

Context in Text Processing

A system has been developed for the representation and application of context information for automatic natural-language-processing systems. Context information is gathered gradually during the reading of the text, and the mechanism provides a way of combining the effect of several different types of context factors. Context factors can be managed independently, while still allowing efficient access to entities. The developer claims that the mechanism is more general than the global focus mechanism used by Grosz (1977) for discourse understanding. Context affects the interpretation process by influencing the processing of a number of important language-interpretation operations, including lexical disambiguation and reference resolution. The types of context factors that have been implemented in an experimental system are: (1) recency of mention, (2) emphasis, (3) task-specific factors, (4) subject area, (5) textual weighting

factors, (6) history of processing, and (7) association. A description and examples are given by Alshawi (1983).

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5/1/84

RESEARCH IN PROGRAMMING LANGUAGES AT THE UNIVERSITY OF NIJMEGEN

by J.F. Blackburn.

Dr. Raymond Boute of the University of Nijmegen, The Netherlands, has studied the application of functional languages to the description of digital systems, has made an appraisal of the language ADA for system reconfiguration to programming in general, and has determined the requirements for dynamic software modification.

Description of Digital Systems

Functional languages differ from traditional imperative programming languages in that they describe computations in terms of expressions and functional definitions rather than commands and procedures. Proving program correctness is made easier because it can be done by transformation of expressions (as in algebra) instead of assertions on a usually complex state space. There is also a close similarity between the data-flow structure of functional languages and that found in digital hardware systems. Therefore, functional languages are quite suitable for the description and analysis of digital systems.

Route has highlighted two aspects of the functional approach to the description of computations and systems: the advantages over imperative programming and the application to digital hardware systems.

The important aspects of any notation are its descriptive power (conciseness, accuracy, and generality of formulation) and its manipulative power (suitability for formal manipulation of descriptions, and for derivation of properties of the described entities). Functional languages derive their descriptive power from their consistent and orthogonal view of functions and their manipulative power from the principle of referential transparency, which permits proof by transformation of expressions as in algebra.

Functional languages are better suited for the description and analysis of digital systems because: (1) most of the theory of digital systems is formulated on the basis of mathematical functions (combinatorial or sequential), and (2) the flow of data in actual hardware is closely matched by the substitution of expressions for function arguments under a suitable semantic interpretation.

The Imperative Programming Style. The semantics of most programming languages is based on commands, the purpose of which is to change a state space. The state space is characterized by the collection of all variables in the program.

In mathematics, every occurrence of a variable in a given context has the same meaning. However, in programming the meaning of a variable may change among occurrences in the same context. In some cases even the description of the meaning of a variable is not constant throughout the program text, because the description sometimes requires the introduction of foreign elements--such as one or more auxiliary variables constituting a projection of the state space.

The principle of referential transparency is expressed as follows. If in a certain mathematical context the variable name X stands for an expression E , then any occurrence of X in any expression in that context may be replaced by E and vice versa. This property is considered self-evident in mathematics and is universally applied in the transformation of algebraic expressions, in the proof of theorems, and in other formal manipulations.

In imperative programming, the principle of referential transparency is seldom valid. Even determining its

validity from the program text requires an analysis of the data flow.

The Functional Description Style. The word "description" is used instead of "program" because the functional style is essentially static and does not imply a certain sequence of steps during execution. This relieves programmers of part of their burden and facilitates the automatic detection and use of opportunities for parallel execution on suitable machine architectures.

The basic units in functional descriptions are expressions, as opposed to the commands in imperative programs. The meaning of symbolic names is established by definitions, and there are no assignment statements that might change this meaning.

In a functional description, the principle of inferential transparency always holds. The rules are as follows:

- General rule: substitution according to the principle of referential transparency
- Specific rules: properties of the operators as determined by axioms or derived from definitions.

The expressive power of functional languages is due to the complete and orthogonal support for functions. As in mathematics, a function f associates with every element of some set A (the domain) exactly one element of some set B (the range). If f is a function and x an argument, then fx always has the same value. A function is defined by means of a function definition $\text{def } fa=E$, where f is the function name, a the formal parameter, and E an expression. A higher order function is one whose argument or result may itself be a function.

A data-type function as defined by domain and range is the most important data type in functional programming. Apart from the usual primitive data types, such as numbers and characters, most functional languages provide the composite data-type list, an ordered collection of items which themselves may be of any type, including lists.

The very general semantics of functional languages is obtained by using a small set of basic concepts in an orthogonal fashion.

Functional Description of Digital Systems. The basic operators of combinational logic can be directly defined in SASL, a functional language designed by Turner (1979) using simple function definitions. Combinational functions can be defined in an abstract fashion at the specification level, or in terms of their gate realization.

A function defined in SASL can be interpreted as follows:

1. The functional interpretation: the abstract mapping (domain to range) realized by the function.

2. The realization interpretation: the logic circuit described by the function definition. Every operator is interpreted as a logic element, and every variable as an interconnection. Also, other interpretations are possible.

A collection of finite-state machines over an input alphabet I , an output alphabet U and a state set Q can be defined as the set $M = (Q \times I \rightarrow Q) \times (Q \times I \rightarrow U) \times Q$.

Each finite state machine is then a triple (next state function, output function, initial state). With these conventions, a typical finite state machine is described in SASL as follows:

```
def machine = next, out, start
where: next qi=<expression>
      out qi=<expression>
      start=<expression>.
```

Since the names next, out, start are not visible outside the where expression, it is convenient to define the following functions:

```
def next m = m1
def out m = m2
def start m = m3
```

(where m_j returns the j th element of a list m). Hence these functions are defined for all machines specified.

The functional-description style eliminates some of the drawbacks in imperative programming. Also, the concept of function, in particular higher order function, constitutes a powerful means for describing and analyzing digital systems.

The Language ADA

Boute is specifically concerned with the language-design aspects of ADA. Some of the considerations are motivated by language requirements arising from an environment in which easy program reconfiguration is important, yet care is taken to keep the review relevant to programming in a wider context. The "classical" language aspects considered are the semantics of types and subprograms, and the "nonclassical" aspects are the support for data abstraction (packages), concurrency (tasks, rendezvous) and exception handling. Boute's conclusion is that the design of ADA is overly restrictive in several respects:

occurrence equivalence violates the referential transparency principle; allowing operator overloading is harmful and unnecessary; packages in ADA are not defined as types, but only as a syntactic means for program organization and visibility control; and exception handling in ADA interferes with other language constructs in complicated ways.

The general view is concerned with the impact of ADA on programming and computer science. It is argued that a substantial reduction in the cost of software, as intended by the US Department of Defense, can be obtained only by programming concepts that are qualitatively different from those presently used in everyday practice. The design of ADA, on the other hand, is conservative.

The introduction of ADA as a standard occurs at a time when concepts that may have an appreciable impact on programming are just coming to fruition; the most important of these probably is functional programming. Boute's conclusion is that ADA as a language standard comes too late as a consolidation of classical programming language concepts, and too early to benefit from new developments.

Requirements for Dynamic Software Modification

Dynamic software modification means the replacement or adaptation of software modules while the system is in operation, without impairing its proper functioning. Boute (1982) discusses some of the requirements leading toward a systematic approach for handling this problem. Of primary concern are the requirements at the language level--particularly the concept of types and abstract data types in a dynamic environment, in view of instance replacement. Following an informal description of the various degrees of abstraction--ranging from axiomatic definition via models to the concrete representation of data types--the relevant issues of type ordering, equivalence, polymorphism, and universal operators were put into this perspective. A secondary topic concerned the support that must be provided by the architecture and the operating system or programming environment for manipulating references to data-type instances subject to replacement and for bringing the actual replacement into effect.

Even though the problem of dynamic software replacement is as old as automatic computing and many *ad-hoc* solutions have been implemented in the past, the more systematic strategies are rather recent.

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5/9/84

VISUAL SENSING FOR ROBOTS AT INRIA

by J.F. Blackburn.

Visual sensing is the major emphasis of robotics research at Institut National de Recherche en Informatique et en Automatique (INRIA), Rocquencourt, France. Researchers elsewhere have been largely concerned with two-dimensional problems of image analysis and understanding. However, at INRIA the need for three-dimensional scene analysis in robotics has been recognized and is a major research effort. New sensors and new methods of representing three-dimensional objects are needed. Among the most promising sensors are the geometrical sensors which provide, in a reference frame, the Cartesian coordinates of points lying on the surface of an object. The sensors give some intrinsic information about the shape of the object and are less dependent on the environment than, for example, a camera which depends on the level of illumination.

Most such sensors use a structural light such as a laser beam, but tactile, optical, and acoustical devices also can provide geometrical information about shapes. In each case, a number of points on the surface of an object are measured and combined with other information, such as the normals to the surface at these points. With a large num-

ber of such points the shape of the object is determined. However, this approach is not the most efficient for answering questions such as the following: What is the shape of the object, its area, its volume? What are the regions that can be recognized by a vision device? What are the stable positions of equilibrium and the associated silhouettes from a given point of view? What are the possible grasping areas?

INRIA has developed a polyhedral representation of objects. An object is represented by a set of three coordinates of points lying on its surface, with a spatial data structure linking them, precisely defined as a graph whose vertices are the measured points and whose edges join the points which are related in some sense. Structures with the fewest edges and which preserve the topology of the surface play an important role. Such a minimal structure is a polyhedron with the measured points as vertices. Polyhedra can approximate any kind of shape, and they have been extensively studied. The storage requirement is proportional to the number of points.

However, the INRIA researchers had to overcome several difficulties. There are several polyhedra whose set of vertices is a given set of points, and the characterization of a polyhedron which suitably approximates the initial surface is not easy. There is also a combinatorial problem. In three dimensions a general polyhedron is defined as a collection T of triangles satisfying three conditions:

1. Two triangles either are disjoint or have one vertex in common, or have two vertices and consequently the entire edge joining them in common.
2. T is connected.
3. For every vertex V of a triangle of T , the edges opposite V in the triangles of T having V as a vertex form a simple polygon.

Based on Delaunoy triangulation and an algorithm developed by J.D. Boissonnat (1983) to represent the volume of an object (a set of tetrahedra) and the surface of this object (a polyhedron which is the boundary of a set of tetrahedra), several applications become feasible.

One can compute the mass properties by looking at the mass properties of the set of the interior tetrahedra--for example, the volume is the sum of these elementary volumes, and the center of mass is the center of gravity of the centers of mass of the different tetrahedra weighted by their volume.

The equilibrium positions are obtained by looking for the faces of the convex hulls of the object, which is approximated by the boundary of the Delaunoy triangulation. The hulls contain in their interior the normal projection onto them of the center of mass.

The interior tetrahedra constitute a mesh which can be used to perform stress and thermal analysis, using finite-elements techniques. This mesh can be improved by adding new points in the interior of the object in order to obtain more regular tetrahedra. These new points may be the center of mass of the much-elongated tetrahedra.

Circular polyhedral approximations can be performed by eliminating points producing elongated tetrahedra. This can be done during the acquisition phase. Only points significantly contributing to the shape of the object need be retained, reducing the storage requirements.

A somewhat different approach to representing three-dimensional objects is called the Prism Tree (Paugeras, 1983). This ternary tree structure is built from an initial triangulation of the object by using a polyhedral approximation algorithm. Different properties of this representation have been determined, as have algorithms for intersecting objects and neighbor-finding techniques.

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4/23/84

EARTH SCIENCE

PLEISTOCENE ICE AGES

by Robert Dolan. Dr. Dolan is the Liaison Scientist for Geology and Oceanography in Europe and the Middle East for the Office of Naval Research's London Branch Office. He is on leave until September 1984 from the University

of Virginia, where he is Professor of Environmental Sciences.

The British Geological Society held its annual meeting at the Royal Institute in London on April 25. The 1-day program, "A Theoretical Framework for the Pleistocene Ice Ages," consisted of nine lectures on topics ranging from Mesozoic climates to mathematical modeling. I was able to attend four of the lectures, including the annual William Smith Lecture, presented by Professor J.M. Imbrie (Brown University, US).

The last lecture of Imbrie's that I had heard was at a Geological Society of America (GSA) meeting more than 20 years ago. At that time, early in his career, Imbrie was exploring the use of multivariate statistical methods in paleontology. His research had a profound effect on many geologists of my generation. I recall thinking after the GSA meeting that factor analysis would serve well to sort out the principal modes of variation of complex coastal data sets--and it has. For this reason I was looking forward to Imbrie's invited lecture, and I can report that none of us in the audience were disappointed. He presented an outstanding lecture, which I will abstract below.

Imbrie presented a "framework" (or design) for investigations of Pleistocene climates; he started with an inventory of the primary components of the climate system, atmosphere, CO₂, aerosols and dust, the oceans, the cryosphere, the biosphere, and the lithosphere. He then discussed the internal processes within the climate system that transfer energy, momentum, and materials between and within the primary components. Next, he discussed the radiative, gravitational, and tectonic boundary conditions of the system. If these boundary conditions are fixed, Imbrie said, the climate state will approach equilibrium with free variations of several types, including shifts between stable states to damped oscillations.

In contrast, forced variations occur if there is a change in the radiative boundary condition (solar or orbital), gravitational condition, or tectonic condition. He then discussed the range of possible variations--free, forced, or resonant interactions.

Each of the external processes which force climatic change--and each of the internal processes which control the response to this forcing (and which also generate free oscillations)--operates at a characteristic rate. Therefore, the mechanisms of climatic change are

frequency dependent. Geologists attempting to explain the Quaternary record must use some form of analysis in which the total record is partialled out among different frequency bands. Imbrie said that "it is this logical imperative, rather than a search for specific, narrow-band cycles, that should prompt a more extensive use of the concepts of spectral and cross-spectral analysis."

Imbrie then summarized the geological progress to date in terms of four frequency bands: (1) the Milankovitch band (oscillation periods from 10,000 to 400,000 years); (2) the tectonic band (more than 400,000 years); (3) the millenium band (400 to 10,000 years); and (4) the decadal band (10 to 400 years). Over the Milankovitch band, there is strong cross-spectral evidence, supported by numerical modeling experiments, that a very high portion (75 percent) of the observed variation in climate may be forced externally by changes in orbital geometry--not only at the main forcing periods (100,000, 41,000 and 23,000 years), but also at certain heterodyne tones (14,700, 11,500 years) derived from them. Recent attention has therefore focused on unraveling the mechanisms by which the climate system responds so dramatically to such modest variations in radiative boundary conditions. For example, there is evidence that CO₂ variations are part of the causal chain linking orbital geometry and climate. Over the tectonic band, changes are externally forced by changes in volcanic fluxes, continental elevation, and continental position. At higher frequencies (short episodes of drought in Africa, the Little Ice Age, and the warm 1940s), it is possible that a significant fraction of the record will be explained as free, broad-band oscillations of the climate system. But at least over the decadal band, evidence is growing that episodes of explosive-volcanism force substantial changes in regional and hemispheric temperatures, and that full activity and lunar tides exert some influence on regional patterns of precipitation.

Imbrie closed his lecture with a statement about the "high excitement" in this era of climatic and geological research. He observed that with richer calibration data and the application of new analytical methods (modeling), geologists may make more progress in climatic research in the next decade than in any other of the past century.

ELECTRONICS

SECOND INTERNATIONAL CONFERENCE ON METAL-ORGANIC VAPOR PHASE EPITAXY

by Nicholas Rottka. Dr. Rottka is a staff member of the Electronic Material Technology Branch, Naval Research Laboratory, Washington, DC.

The Second International Conference on Metal-Organic Vapor Phase Epitaxy, organized by the British Association for Crystal Growth, was held in Sheffield, England, from 10 through 12 April 1984. The proceedings are being published in the *Journal of Crystal Growth* this summer.

Metal-organic vapor phase epitaxy (MO-VPE) is an epitaxial growth technique used in the fabrication of homostructure and heterostructure semiconductors such as GaAs, InP, AlGaAs, and CdTe. It complements other epitaxial-growth techniques, such as liquid phase epitaxy (LPE), molecular beam epitaxy (MBE), and hydride/chloride VPE. Its rapid development in the past 5 years has been due, in part, to its promise as a leading technology in producing custom-made heterostructures for integrated circuits, electro-optics, and novel high-speed devices such as the high electron mobility transistor (HEMT).

If attendance is a measure of growth in a new field, then it is safe to say that MO-VPE is indeed growing. Conference participation has doubled since the first international conference was held in France 3 years ago. The number of contributed papers has more than doubled. The sessions were broadly divided into topic areas such as organometallic chemistry (synthesis of alkyls and adducts), growth mechanisms in MO-VPE, characterization of films, heterostructures/superlattices, optoelectronics, photolysis/selected area deposition, and safety.

One of the issues addressed was the abruptness of heterojunctions in materials grown by MO-VPE. Martin Leys (Philips Research Laboratory, Eindhoven, The Netherlands) reported on a convection-type vertical reactor in which he was able to grow very abrupt (7-angstrom) GaAs/AlAs layers. This bottom-fed "chimney" reactor with samples mounted on thin susceptors flat against the vertical walls allows very laminar (and a thin boundary layer) flow near

the sample surface. Growth was done at 700°C, at 1 atmosphere, with a 7.4-L/min hydrogen carrier flow. All source flows were computer controlled. Transmission electron microscopy (TEM) was used to determine the thickness of the layer. Lattice imaging was able to resolve the two-monolayer abruptness from one material to the other. Superlattice structures of 7-angstrom GaAs between 50-angstrom $\text{Al}_x\text{Ga}_{1-x}\text{As}$ looked extremely smooth. This presentation demonstrated the flexibility and controllability of the MO-VPE process in growing very sophisticated crystal structures on par with MBE.

J.P. Andre (Applied Physics Laboratory, France) reported on a (AlGa)As HEMT device (SI GaAs/buffer (AlGa)As/undoped GaAs/undoped spacer (AlGa)As/Si doped (AlGa)As), which yielded a mobility of 7000, 100,000, and 173,000 $\text{cm}^2/\text{V}\cdot\text{sec}$ at 300, 77, and 40°K, respectively. The $1.2 \times 240\text{-}\mu\text{m}$ TiPtAu gate, two-dimensional, electron-gas field effect transistor gave a transconductance (in the dark) of 177 and 342 mS/mm at 300 and 77°K, respectively. These results look promising when compared with the best HEMT structures made by MBE (300 and 500 mS/mm at 300 and 77°K, respectively). The MO-VPE HEMT structures were grown on a large (20-cm^2) GaAs substrate. The consensus was that the lower mobilities found in MO-VPE grown HEMT structures are due to the lower purity of the undoped GaAs active layer. Some of those at the conference felt that the MO-VPE community is becoming too complacent with its accomplishments and not doing enough impurity-related research. Only one of the poster papers addressed this problem ("Factors Influencing the Purity of MO-VPE Grown GaAs," by J.E. Andrews from the Research Triangle Institute).

Another major issue addressed was MO-VPE in opto-electronics. Both R.D. Burnham (Xerox) and S. Hersee (Thomson-CSF, France) presented invited papers on GaAs/AlGaAs quantum well (QW) lasers. Both groups have fabricated low-threshold-current (100-mA) QW lasers using MO-VPE technology. Single- and multiple-QW structures with abrupt and graded walls have been fabricated. Graded (AlGa)As layers help to thermalize the injected carriers and enhance confinement of the carriers to the emitting QW region. Both infrared and visible lasers have been fabricated. Burnham reported a long-lifetime, 100-mW, phased-array laser and a tunable (over 700-angstrom) visible laser.

There were many presentations relating to doping in MO-VPE; this area of research is growing. There is a

continuous search in MO-VPE for better n- and p-type dopants for all the III-V and II-VI compounds and alloys--dopants that are stable in the lattice (do not outdiffuse with processing) and incorporate over a large range of concentration. In addition to S, Se and Te, Si and Sn are being used as n-type dopants. Silane is the most common source for Si. Si incorporates readily in GaAs and AlGaAs at high growth temperatures. But silane does not crack readily in the 550 to 700°C range. T.F. Kuech (IBM) reported using disilane as a source for Si doping of GaAs to circumvent some of the temperature-dependence problem found with silane. The decomposition reaction of disilane was very efficient, reducing the amount of dopant gas required by about two orders of magnitude at the lower growth temperatures. Compensation was very low, and net carrier concentration of $5 \times 10^{18} \text{cm}^{-3}$ was achieved. Unlike with silane, the carrier concentration does not vary with composition and group V-III source ratio when doping AlGaAs with disilane. J.D. Parsons (Hughes Research Laboratory) and A.P. Roth (NRC, Canada) reported using tetramethyl tin as a source for n-dopant in GaAs. Sn concentrations can be controlled over four orders of magnitude, and net carrier concentrations can be higher than Si (without surface pile-up). Both Si- and Sn-doped homojunction showed very abrupt profiles. P-type dopants are still a problem. Both Zn and Cd have been used in the past as p-dopants in GaAs and AlGaAs, but they are not very stable in the lattice, especially when undergoing high-temperature processing. M. Druminski et al. (Siemens, Germany) and P. Frijlink (Laboratoires d'Electronique, France) reported using bis-cyclopentadienyl Mg as the source for p-doping. My paper discussed doping AlGaAs with Be using diethylberyllium as source. The incorporation of Be is efficient, and net hole concentrations in the mid 10^{18}cm^{-3} have been achieved. Analysis by surface ionization mass spectroscopy showed a very abrupt doping profile.

One of the pleasant surprises of the meeting was that In-containing compounds and alloys are no longer as difficult to synthesize by MO-VPE as they once were. Some early work in growing InP and InGaAs from trimethylindium (TMI), trimethylgallium (TMG), phosphine, and arsine was plagued by parasitic side reactions between the TMI and phosphine, giving rise to nonvolatile polymer products. These side reactions depleted the indium available for nucleation on the substrate and made growth of InP and stoichiometric InGaAs

or InGaAsP most difficult. Two approaches were taken to solve this problem. The first involved growth at low pressure to reduce polymer formation. The second approach was to use as sources adducts such as TMG-TMAs, TMI-TMAs, and TMI-TMP. These preformed (or *in-situ* formed) adducts do not form polymer reactions with the phosphine. Both approaches have yielded high-quality InP, InGaAs, InGaAsP, and GaInP.

Many presentations dealt with the adduct approach in synthesizing materials. R.H. Moss (British Telecom) and F. Scholz (University of Stuttgart) presented papers on this subject. Recent reports from the US and the UK indicate that the additional complexity of growing at low pressure or using special adducts may not be necessary to grow high-quality InP. Papers presented by G.B. Stringfellow (University of Utah) and S.J. Bass (Royal Signals and Radar Establishment [RSRE], UK) reported successful growth of high-quality InP using TMI and phosphine in an atmospheric pressure reactor. Bass reported undoped InP $N_D - N_A = 8 \times 10^{14} \text{ cm}^{-3}$, $\mu_H(300) = 5200$, $\mu_H(77) = 74,000 \text{ cm}^2/\text{V-sec}$; undoped $\text{Ga}_{0.47}\text{In}_{0.53}\text{As}$ on InP $N_D - N_A = 6 \times 10^{15} \text{ cm}^{-3}$, $\mu_H(300)$ in excess of 10,000 and $\mu_H(77) = 38,000 \text{ cm}^2/\text{V-sec}$. Their success in avoiding some of the polymer problems stems from the use of a high-purity TMI source. It is believed that early work in this area was hampered by contaminated TMI sources. Impurities acting as catalytic agents lead to parasitic side reactions. There was general optimism about the future of In-containing compounds grown by MO-VPE.

J.B. Mullin (RSRE) presented an overview on MO-VPE of narrow-gap II-VI compounds. He stressed primarily the chemistry associated with adduct formation and the decomposition characteristics of the MO-sources. J. Tunnicliffe (RSRE) presented a new MO-VPE technique to grow HgCdTe using dimethylcadmium, diethyltellurium, and liquid Hg in a two-heat-zone Bass-type reactor. He grew alternate thin layers of HgTe and CdTe at 410°C. There was a growth stop of several minutes' duration between layers to allow interdiffusion (thus alloying) to take place. The composition of the $\text{Hg}_x\text{Cd}_{1-x}\text{Te}$ is determined by the ratio of the layer thicknesses, $x = t_2/(t_1+t_2)$. He calls this an interdiffusion multilayer process. Epilayers had good depth and lateral uniformity and a reflective surface finish. Tunnicliffe did not mention whether they had been used successfully in fabricating infrared detectors.

There was an extensive review presentation by M. Razeghi (Thomson-CSF,

France) on growth, characterization, and devices of GaInAsP/InP using low-pressure MO-VPE. The successes are numerous:

1. Undoped InP $N_D - N_A = 5 \times 10^{14} \text{ cm}^{-3}$, $\mu_H(300) = 5350$, $\mu_H(77) = 60,000 \text{ cm}^2/\text{V-sec}$.

2. Undoped $\text{Ga}_{0.47}\text{In}_{0.53}\text{As}$ $N_D - N_A = 3 \times 10^{14} \text{ cm}^{-3}$, $\mu_H(300) = 12,000$, $\mu_H(77) = 60,000 \text{ cm}^2/\text{V-sec}$.

3. The observation of two-dimensional electron gas in ternary GaInAs/InP and quaternary (Q) $\text{Ga}_{0.25}\text{In}_{0.75}\text{As}_{0.5}\text{P}_{0.5}/\text{InP}$ heterojunctions.

4. Superlattices and quantum size effects with the ternary and quaternary InP systems.

5. The lowest reported threshold-current-density Q/InP DH laser emitting at 1.3 μm (430 A/cm² for a cavity length of 950 μm).

6. InP/GaInAs/In very-high-speed pin photodiode exhibiting quantum efficiency of 60 percent for $V > 25 \text{ V}$ and dark current of $2.6 \times 10^{-4} \text{ A/cm}^2$.

The Third International Conference will be held in Pasadena, CA, in 1986.

5/10/84

MATERIAL SCIENCES

ASSESSMENT OF THE INTEGRITY OF STRUCTURES CONTAINING DEFECTS--THE CEGB APPROACH

by Kenneth D. Challenger. Dr. Challenger is the Liaison Scientist for Materials Science in Europe and the Middle East for the Office of Naval Research's London Branch Office. He is on leave until May 1986 from the Naval Postgraduate School, where he is Associate Professor of Materials Science.

This is the first of several articles that will examine the activities of the laboratories of the UK's Central Electricity Generating Board (CEGB). The CEGB is part of the publicly owned electricity utility of England and Wales. It is a statutory corporation responsible for developing and maintaining a supply of electricity for the country. It is one of Britain's biggest businesses, and its integrated electrical supply system is one of the world's largest.

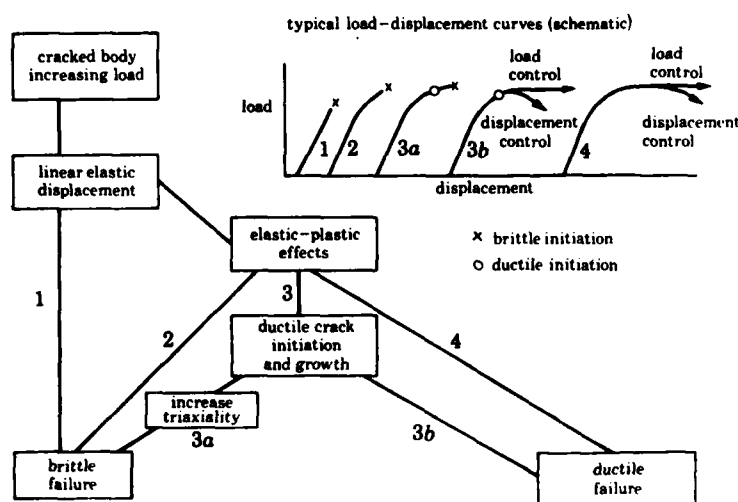


Figure 1. The five loading paths to failure (from Harrison and Milne, 1981).

Research to support this business is divided among five regional and three division laboratories. The regional research laboratories employ over 1200 staff, and the three division laboratories employ over 2000. These laboratories are primarily supported by revenues from the CEBG; however, individuals are encouraged to solicit sponsored research. The Electric Power Research Institute supports several research projects at the CEBG laboratories.

Located in Leatherhead, England, the Central Electricity Research Laboratory (CERL) is the largest of the CEBG's laboratories. The laboratory is divided into eight branches: Chemistry, Electrical Engineering, Materials, Applied Physics, Control and Instrumentation, Engineering Sciences, Biology, and Laboratory Services. The Materials Branch (headed by Dr. I.L. Mogford) is divided into three sections: Power Generation Materials (Dr. R.D. Townsend), Oxidation and Corrosion (Dr. B. Meadowcroft), and Metallurgical Engineering (Dr. I. Milne). The main strengths of the Materials Branch are elevated-temperature mechanical behavior, fracture mechanics, environmentally assisted fracture, and oxidation in CO_2 .

This article summarizes the status of the laboratory's work on assessing the integrity of structures containing flaws. Their methodology is called R6, after the report number assigned when it was first published in August 1976. Since 1976 the procedures have been revised twice, and a third revision is in progress.

An example of a typical problem that would be addressed by R6 is prediction of the load to cause failure in any structure containing a crack. The deformation of the structure may follow any of the five loading paths shown schematically in Figure 1. These load-displacement paths range from completely brittle (path 1), where failure occurs abruptly, to plastic collapse (path 4), where the load-displacement curve is continuous and failure occurs only after large displacements.

The R6 procedures use a failure-assessment diagram to evaluate the likelihood of failure (Figure 2). This diagram contains a curve that represents the failure conditions. The curve is limited by linear elastic fracture mechanics concepts ($K_r = K_I/K_{IC}$) on its ordinate and by the stress to cause plastic collapse ($S_r = S/S(a)$, where $S(a)$ is the plastic collapse stress as a function of crack length) on its abscissa. Interpolation between these limits has been the subject of considerable debate, and thus the subject of the on-going research on this topic. Presently the interpolation is done using a Dugdale-Bilby strip yielding model (see Dowling and Townley, 1975, for a description of the application of the Dugdale-Bilby model). Failure is assumed to have occurred when the coordinates of any point (K_r, S_r) fall on or outside the assessment line. Many laboratory and large structural tests (including some on entire pressure vessels) have been performed in the process of developing and validating the

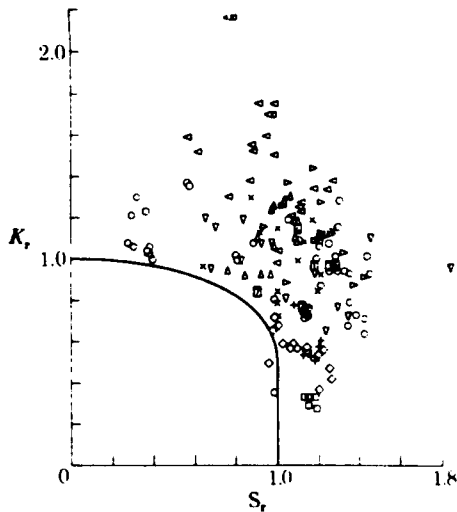


Figure 2. R6 failure-assessment diagram with test data illustrating the validity of the R6 assessment procedures (from Harrison and Milne, 1981).

R6 procedures. The results of all of these tests are plotted on Figure 2; these clearly indicate that for the materials tested (mostly A-533 pressure vessel steel and high-strength aluminum alloys) the assessment line is a good lower-bound-failure avoidance criterion.

The two parameters used in the construction of the failure-assessment diagram, K_I and S_r , do not include any consideration of crack growth, but will only predict the conditions that lead to the initiation of cracking. When cracks grow by a ductile fracture mechanism, the load-bearing capacity of a structure is often much larger than the load required to initiate cracking (this is why most of the failure points on Figure 2 are so far outside the assessment curve). Two recent developments in the understanding of the mechanics and mechanisms of ductile crack growth have allowed the extension of the R6 procedures to include ductile crack growth. Firstly, Chell has shown that the R6 failure assessment curve is, for all practical purposes, a normalized J-integral curve. (The J integral is the most widely accepted method to characterize elastic-plastic fracture.) Secondly, the J integral concept has been extended (Hutchinson and Paris, 1979) to include some ductile crack growth rather than just describing the conditions required for the initiation of crack growth. These two advances in the understanding of ductile fracture now allow the determination of the margin between the load for the initial crack growth and

the full tolerance load of the structure to be assessed.

The R6 has been revised to allow ductile crack growth such that these procedures are now capable of analyzing the load-displacement paths 1, 2, 3, 3a, and 4 shown in Figure 1. Path 3b is sensitive to the local stress-strain conditions at the crack tip and to the local material properties. This path--i.e., ductile crack initiation followed by brittle fracture--only occurs when materials are used near their ductile to brittle transition-temperature range. If this type of behavior is expected, R6 can be used to predict the initial crack growth, point 3, and this could then be used as a conservative estimate of failure.

The materials used in the validation testing program do not strain-harden appreciably before fracture (the HY-series steels used for naval vessels are in this category). When materials that do undergo considerable strain hardening (the austenitic stainless steels, for example) are assessed by R6 procedures, they do not conform to the failure-assessment line. This has been the focus of the criticisms of the CEBG procedure.

The CEBG researchers have published these limitations of their methods (Milne, 1983) and are in the process of developing another modification to R6 that will account for the large strain-hardening capacity of some materials. The great advantage of the R6 methodology is that it is simple to use, and clear instructions for its use, with worked examples, have been published.

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5/10/84

COMPOSITE MATERIALS RESEARCH IN DENMARK AND THE NETHERLANDS

by Tsu-Wei Chou. Dr. Chou is Professor of Mechanical Engineering at the University of Delaware.

This is the final article in a series on European research in composite materials. Research at Risø National Laboratory, Denmark, and the Fokker Aircraft Company, The Netherlands, is featured this month.

Composite Materials in Denmark

Interest in composite materials research and application in Denmark is growing very rapidly. Major research laboratories involved in fiber composites are: Risø National at Roskilde, the Technological Institute at Gregersensvej, Tåstrup, Jydsk Technological Institute at Århus, and the Technical University of Denmark at Lyngby. Here I concentrate on the work at Risø National Laboratory, which has the most extensive research effort.

Fiber composite material research at Risø is conducted mainly in the Metallurgy Department, although the Chemistry Department is studying the effect of radiation on resin curing and fiber-matrix interface problems.

Work on composite materials in the Metallurgy Department originated from studies of the mechanical properties of two-phase materials, in particular dispersion-hardened metals. The work has been expanded to include composites based on metals and polymers as well as their practical applications. A major research activity concerns the mechanical properties of fibrous composite materials; both short- and long-term behavior are included in the work.

The study of short-term properties covers the elastic and plastic deformation characteristics of fiber composites. The work is both theoretical and experimental, with special reference to metal matrix; the understanding of single-phase metals is used in analyzing composite materials. The long-term properties under investigation are creep and fatigue. The creep studies concentrate on metal matrix and the creep of unreinforced metals; theoretical and experimental work is carried out. An extension to polymeric composites is planned. The fatigue studies include damage mechanisms and damage characterization--particularly for polymer composites. The change of stiffness and strength in relation to damage is studied, and models for predicting lifetime in fatigue are being developed. Fundamental studies of the fatigue of metals will be used in analyses of the fatigue of metallic composite materials.

Mechanical testing of composites is carried out as part of the studies mentioned above and in order to establish data for engineering use. Test

methods for short- and long-term properties are being investigated for uni-axial and biaxial loading. Fabrication technology for composite materials is also established in the laboratory--both for fabricating test coupons and for manufacturing small components. The techniques are filament winding and high-temperature curing of laminates in a small autoclave. The characterization and quality control of the fabricated materials are done by various physical and chemical methods. Nondestructive testing, based on existing expertise in the department, will be applied to composite materials. The department also does consulting work under contract for the Danish government and for Danish industry. This part of the department's program relates mainly to materials selection for stiffness- and strength-critical components of low weight (e.g., wingblades for wind turbines); the related fabrication technology, material quality control; and mechanical properties.

The financial support for the composite materials program comes from internal Risø funding, the Ministry of Energy, the National Agency of Technology, and industrial contracts.

Fokker Aircraft Company

Recognizing the importance of research and development of advanced aircraft structures based on modern materials and manufacturing processes, Fokker Aircraft Company established its Manufacturing Research and Product Development Department and its Technological Centre nearly 30 years ago.

The Technological Centre is located at the main site of Fokker at Schiphol Aerodrome. A well-equipped subsidiary laboratory at the Ario Fokker plant at Ypenburg airbase, the location of the main fiber-reinforced-plastics production unit, shares with the Technological Centre the research and development for work on fiber-reinforced-plastic and unreinforced-plastic products. The typical tasks carried out at the Centre include the research and development in innovative structural and manufacturing concepts for aircraft and satellites, advanced nondestructive inspection techniques for quality control of advanced structures, and durability improvement of high-strength metal.

The Technological Centre is well known for its special expertise in the technology of bonding metal/advanced-composite hybrids. For instance, hybrids of adhesively bonded thin aluminum sheets and advanced composites have demonstrated excellent mechanical

properties in tensile strength and fatigue-crack resistance.

At its Hooerveen plant, Fokker is conducting a major carbon-composite project dealing with landing-gear doors for the Airbus Industry A310 and A300-600S. Work is also going on for carbon-composite horizontal stabilizers, rudders, and vertical stabilizer leading edges for General Dynamics F-16s. Fokker expects its next generation of transport aircraft, which is to be introduced in about 1992, to be 50 to 65 percent carbon composites.

5/23/84

OCEAN SCIENCES

REMOVAL OF OFFSHORE PLATFORMS

by Robert Dolan. Dr. Dolan is the Liaison Scientist for Geology and Oceanography in Europe and the Middle East for the Office of Naval Research's London Branch Office. He is on leave until September 1984 from the University of Virginia, where he is Professor of Environmental Sciences.

Offshore oil and gas producers face a monumental problem in the future as the more than 2500 structures they have constructed on the continental shelf (100 in the North Sea) must be "decommissioned"--that is, removed. This was the topic of a recent lecture and discussion in London at the Royal Institute of Naval Architects.

To date 600 offshore structures have been removed, but they were small and from shallow-water locations. The problem is going to become significant in about 20 years when the really big ones, now on location or under construction, are de-activated after the oil and gas fields are depleted. But why remove them at all? Because it's required in many areas by international conventions. There are several other reasons, too. Some platforms are so severely damaged due to operational difficulties (such as seabed movement) that they must be salvaged and replaced. Another reason is for safety for seagoing vessels--because many platforms are located in navigable waters and shipping lanes, so the operators, to reduce liability, will probably consider removing them even if the regulations of the country in question do not require this. Finally,

in some cases production structures may be refurbished and used on another site.

The major decision facing the operators is what to do with the structure once it is removed. The options are: refurbish it; cut it up and sell it for scrap; sink it in ultradeep water; donate it to a fish and wildlife agency for use as an artificial reef; or leave it, when regulations permit, and assume the risk of future liability.

The plugging of wells and decommissioning of a massive offshore platform is a major and very expensive operation. Some of these structures originally cost more than \$1 billion and took years to build. Taking them apart on site rather than in a fabrication yard will further test the engineering skills of the industry.

According to F.A. Ramzan and D.T. Blanken (Brown & Root Ltd., UK), the value of a structure generally does not make removal for scrap an attractive option. The current value for scrap steel is around \$35 per ton, and the market is dictated by the scrap dealers. They know that the operators must sell and will require that the steel be delivered to an acceptable destination in manageable sizes.

In addition, the transportation of large pieces of the platforms is a major cost for the operators. In some cases, the procedure is the reverse of installation, with the additional complexity of placing large pieces of steel on a barge in an offshore environment, thereby increasing the recovery cost.

If the structure is to be reused, the overall condition of the platform has to be good. For general reuse at another location, small structures present no major problems as they can be removed, refurbished, and reinstalled with relative ease. The structures, which can serve as small work platforms, are usually designed for shallow-water installation and provide single-well protection against impacts from small boats.

The reuse of massive platforms, however, presents additional problems. Ramzan and Blanken said that the refurbishment process requires more than just checking for fatigue and corrosion damage. The criteria used for the original design may not meet the current requirements, as these criteria commonly change over the life of the platform. So any platform that is reinstalled must be brought up to current design standards.

In some cases the entire structure must be re-engineered to accommodate the different environmental conditions at the new location. This will, in general, require steel to be added and

possibly removed at various points, a very expensive process. And there is a general feeling among operators that steel which has been exposed to the saltwater environment for 15 years or more is only good for scrap; they will not assume the risk of further use.

Using a platform for an artificial reef or for deep-water dumping requires additional considerations. There are many sites, in both the northern North Sea and the Gulf of Mexico, where deep-water dumping could be done. These places are adequate for disposal from the standpoint of interference with shipping and fishing; the problems with this disposal stem mostly from gaining permission from government regulatory bodies and satisfying environmental and fishing organizations.

Marine biologists have long recognized that artificial reefs lead to an increase in the fish population and generate new fishing grounds in areas previously unpopulated. The practicalities involved in removing such structures depend largely on their size and type--i.e., concrete gravity type or conventional steel jacket. For self-floating substructures, dumping at sea is relatively easy. The cost of breaking up the structure and loading sections on a barge is eliminated.

Dumping nonbuoyant barge-launched steel structures requires special equipment, such as specialized cargo-dumping barges or frames which can be designed to release the load. It is not possible to release a heavy load from a crane hook, because the whiplash effect would seriously damage the crane boom.

Ramzan and Blanken noted that the requirements of towing a large platform in one piece to a deep-water site or to any other location introduce additional problems. For a successful tow, skilled engineers and seamen are needed, and crane vessels of adequate capacity must be available.

The equipment now available is adequate for most of the removal jobs over the next decade. Although most of the vessels were designed for installation of platforms, minor modifications would make them equally suitable for removal. Sophisticated lifting vessels will be needed, and so will the entire fleet of offshore support vessels--i.e., tugs, remote controlled vehicles (RCVs), cargo barges, and temporary accommodation support facilities.

Finally, divers will be needed for the removal and salvage operations, with additional risks involved with the use of gas cutting equipment and explosives; consequently, the cost will be high. RCVs probably could play a major role in

the recovery operation; they would be used for placing underwater charges, jetting, and connecting lifting gear. RCVs are attractive; when they can be used, human lives are not endangered, and they minimize the need for deep-water saturation diving. Now about 120 unmanned RCVs and 148 manned submarines are used for oil and gas operations.

Removing offshore platforms will be a topic of increasing discussion as the structures are decommissioned. The conclusion reached at this meeting was that the technology for removing platforms is currently adequate; however, the cost and complexity of the undertaking will surprise many of the operators. Removal costs might exceed 15 percent of the original cost of the structure. Consequently, this may make some operators consider installing structures that not only will serve the purpose of oilfield production but also will be simple to remove. With the need to remove an offshore structure after production is complete, oil companies will have to consider such costs in the development of oil fields. This may make short-life, marginal fields unattractive if conventional platform systems are adopted.

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SYNTHETIC APERTURE RADAR AND OCEANOGRAPHY

by Robert Dolan.

The UK Remote Sensing Society held a meeting on "Active Microwave (SAR) Sensing of the Oceans" at the Royal Aircraft Establishment (RAE, Farnborough) on 4 April 1984. The program consisted of 10 presentations: four on swell and waves, three on internal waves, two on data analysis, and one on a specific UK experiment. The full text of the papers is available from the Remote Sensing Society (Dale Lodge, c/o Department of Geography, University of Reading, Reading RG9 2AU).

The meeting was not a state-of-the-art review of synthetic aperture radar (SAR) and its application in oceanography. The papers were specific, with little connection between them. I was disappointed that there wasn't an opening presentation providing an overview of recent trends in SAR, or at least an overview of the goals of the meeting. Perhaps this was less of a problem for

the specialists in SAR, but many attending the meeting felt as I did.

The one presentation that I would like to mention in this article was made by Dr. G.E. Keyte (RAE); he discussed the British experiments with SIR-B coming up this fall. The US National Aeronautics and Space Administration SIR-B Space Shuttle mission will probably fly in September or October. The British research team consists of two groups, one working with shallow-water bathymetry and seabed morphology, and the other with deep-water oceanography, mostly waves.

The shallow-water team will focus on the shelf area of the Bristol Channel on the Norfolk coast. This is the same area that was widely publicized with the excellent Seasat SAR image of large-scale sand waves, internal waves, and ship wakes. The experiment will consist of a major effort to provide ground truth on the site as the Space Shuttle passes over with the SAR. This experiment will include wave buoys, current meters, atmospheric measurements, and a ship making side-scan sonar runs to provide detailed calibration of the bathymetry. These field measurements will be made during several Shuttle passes, through different tidal states.

The deep-water team has selected a field site at 47°N-17°W, a location about 1200-km west of Spain. Emphasis in this experiment is on the measurement of internal waves and swell. There will be two ships on site deploying instruments to measure the spectrum of oceanographic variables. In addition, high-resolution aerial photography is included for analysis of fine structure at the surface.

The SAR data will be analyzed in the UK, including experiments in digital imaging analysis and enhancement. And since the Shuttle's orbit will vary from 320 km to 225 km, calibration for location is to be made with a series of 3-m² reflectors located on the paths of the orbits.

I believe that the entire experiment, both shallow water and deep water, is well designed and supported. The only environmental problem that could alter the outcome significantly would be a period of calm seas during the Shuttle's flight. When this question was raised, someone on the team said they may take along some 300-kg depth charges to ensure at least some wave action.

SCIENCE POLICY

HOLLAND'S SCIENCE POLICY AND BUDGET

by James W. Daniel, Scientific Director for Europe and the Middle East for the Office of Naval Research's London Branch Office. Dr. Daniel is on leave until August 1985 from The University of Texas at Austin, where he is Professor of Mathematics, of Computer Sciences, and of Education.

Over the past 20 years science policy in The Netherlands has steadily become more centrally determined with regard to both general principles and specific funding of projects. Recent developments seem to be orienting the system more toward market technology than toward basic science as policy leaders struggle with a weak economy, decreases in the real value of government support of research, and industrial research funding that--though increasing--is viewed as being only about two-thirds of what it should be.

History

In 1945 The Netherlands was essentially a collection of sleepy little farming communities with little industry. Peaceful labor relations, low wages, and the spinoff from the phenomenal post-war development of Germany helped the Dutch develop industrially through the 1950s and 1960s. By 1966 the government realized, as had other European nations earlier, that science was essential to industry; Parliament established the Advisory Council for Science Policy (Raad van Advies voor het Wetenschapbeleid, or RAWB) and asked the Cabinet to prepare a list--the Science Budget--of expenditures on R&D from the national budget.

The next major step in the development of a science-policy structure came in 1973: the new government created a Ministry of Science Policy under Mr. F.H.P. Trip. Within 3 years Trip had his suggestions adopted by Parliament, calling for research to be geared to community priorities and for the government to promote the quality, effectiveness, and democratization of research; "democratization" was taken to mean participation in the determination of research policy by research workers, research consumers, and the public generally. The ministry was also told to "break down the sometimes excessive autonomy of research institutions and extend the government's influence ...

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over research so that plans can be drawn up on which the individual ministers and the Minister for Science Policy can decide on the basis of agreement." Thus was central planning born.

The minister's powers continued to expand. In 1978 the ministry was provided funds to stimulate research in new areas and was made responsible for the Organization for Applied Research (Nederlandse Centrale Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, or TNO); see the next article for information on the TNO and its nearly 40 research laboratories. In 1979, responsibility for stimulating technological innovation was added to the ministry. By this time, Parliament was beginning to be less agreeable to the minister's proposals--money was becoming tight--and to feel that the ministry needed to be coordinated with the Ministry of Education and Science, which provides the research funds for universities. When the minister died in 1981, he was not replaced; rather his organization was transplanted as the Directorate for Science Policy under the Minister of Education and Science, who was thus given the science-policy portfolio. In 1983, responsibility for technology policy was shifted to the Ministry of Economic Affairs (see the article on page 442). And that's the organization today.

The Present Structure

Because of the interaction between basic science and technology, responsibility for policy now seems to be split between two ministries: Education and Science, and Economic Affairs (see the article on page 442 for a description of this situation and of the role of the Directorate for Technology Policy). In addition, every ministry has funds to support research in areas of special interest. The two policy directorates attempt to provide coordination for all these diverse efforts, primarily by discussion and persuasion. Another source of advice to the government is the RAWB, similar to the National Science Board in the US; the RAWB cannot address the budget, however--merely scientific priorities. All of the ministries are gaining increased influence on policy at the practical level through changes in the way funds are allocated.

About half of the government's contributions to support research goes in lump-sum allocations to 13 universities to pay for research associates and assistants, technicians, and the like; the other half goes to research institutes. Until recently, the government played no role in how the universities

spent the research funds; 2 years ago this changed. Now, 50 percent of the available government funds for university research are allocated, as before, in proportion to student enrollment; the remainder is allocated through "conditional financing." In this latter approach, universities propose specific research projects for groups of 5 to 10 persons over 5-year periods; nationwide committees will judge the proposals and decide which to approve. A small fraction of the conditional funds will be restricted for use in priority areas determined by the government.

Additional research funds flow to the universities through the organization for pure research (Nederlandse Organisatie voor Zuiver Wetenschappelijk Onderzoek, or ZWO), although these amount to only about 7 percent of university research funds. Recent changes at ZWO have forced the creation of priority areas there, in which research proposals are much more likely to be funded (see the next article for further information on the ZWO and the further changes it may be facing).

Three types of research institutes can be distinguished according to their funding sources: the ZWO, the TNO, and individual ministries. ZWO institutes are essentially as independent as the ZWO. The TNO institutes have been reorganized recently--see the next article--so that they are much more centrally administered and are more influenced by the ministries interested in their work. And the ministries obviously control their own institutes, such as that for energy research.

The ministries naturally are concerned that research is performed in support of their missions; increased ministry influence on science policy has therefore caused concern in the science community that basic research may well suffer as a result. The recent Zegveld Report presented to Parliament by the Economic Affairs Minister explicitly calls for a more market-oriented policy, for example. With limited budgets, increased emphasis on applications and on development implies decreases for pure research.

Budgets

Science and technology policy can only be implemented through the budget, and budget trends obviously influence strongly what policy is adopted. Table 1 gives a picture of the trends in R&D support in the last 5 years in The Netherlands. Public support has stayed steadily at about 0.93 percent of the gross national product (GNP), while industry funding has gradually grown from 0.96 percent to 1.04 percent of the

Table 1

Research Expenditures in The Netherlands (inflation rates of The Netherlands were used, and the conversion \$1=f1.3 was assumed)

	Public Funds to Universities		Public Funds Elsewhere		Total Public Funds		Total Industry Funds		Total Funds	
	current \$ millions	1980 \$ millions	current \$ millions	1980 \$ millions	current \$ millions	1980 \$ millions	current \$ millions	1980 \$ millions	current \$ millions	1980 \$ millions
1980	475	475	560	560	1035	1035	1075	1075	2110	2110
1981	485	460	610	585	1095	1045	1160	1115	2255	2160
1982	495	450	645	580	1140	1030	1235	1135	2375	2165
1983	490	420	675	580	1165	1000	1295	1145	2460	2145
1984	485	410	700	590	1185	1000	1335	1155	2515	2155

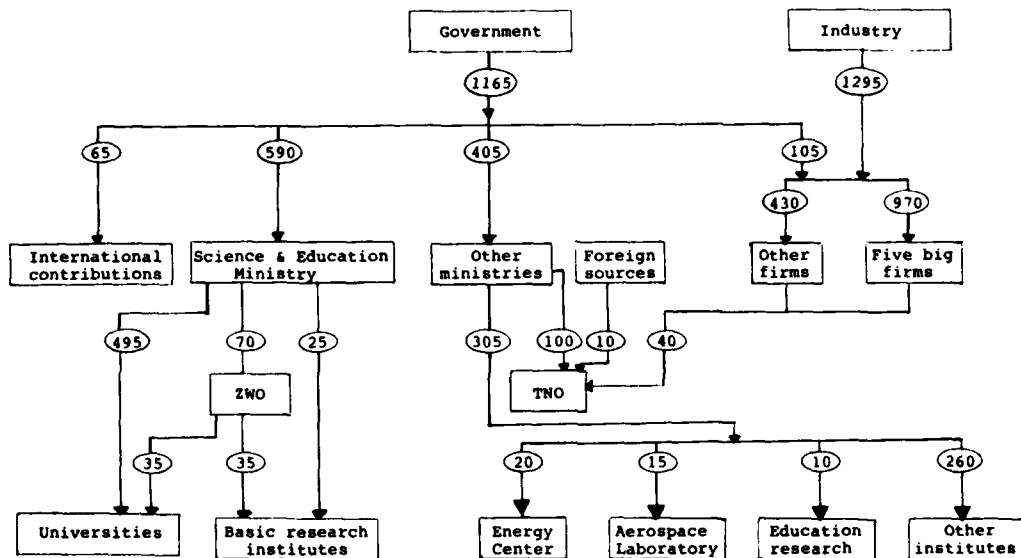


Figure 1. The 1984 funding of research in millions of dollars, using \$1=f1.3.

GNP. The total of about 2 percent compares unfavorably with the 2.5 percent typical in most industrialized nations; the Zegveld Report argues that this shortfall should be eliminated by industrial rather than public funds--thus requiring industry to boost its 1.04 percent to 1.57 percent. The 1984 expenditures by the government, by sector and in millions of dollars, will be approximately:

Energy	95
Agriculture	130
Development	30
Defense	40
Health	280
Environment	105
Planning	5
Maritime	15
Construction	20
Transport, communication ...	35
Public works	15
Technology	605
Social	140
Fundamental research	630

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RESTRUCTURING HOLLAND'S PURE AND APPLIED RESEARCH ORGANIZATIONS

by James W. Daniel.

Major changes in the structure and funding of The Netherlands' organization for applied research (Nederlandse Centrale Organisatie voor Toegepast

Natuurwetenschappelijk Onderzoek, or TNO) have taken place in the last 3 years in order to provide more central control and direction to the TNO's about 40 institutes, bureaus, and centers. Further changes are planned in order to support the government's market-oriented technology policies. Some of the same types of shifts are taking place or being considered for the organization for pure research (Nederlandse Organisatie voor Zuiver Wetenschappelijk Onderzoek, or ZWO). One effect of the changes is to reduce the flexibility and freedom in the Dutch system for supporting R&D.

The TNO

The TNO was created by law in 1930 as a mechanism for supporting and stimulating applied research of service to the nation; it is an independent not-for-profit organization supported primarily by government funds. It conducts applied R&D in its own institutes, centers, and bureaus, rather than by contract with other organizations. Various TNO laboratories have developed world-class strengths in such areas as physical separation technologies, genetic engineering, marine ecosystems and other environmental sciences, simulation of equipment and processes, long-term wear and mechanical properties of plastics, and welding technology.

Prior to the late 1970s, the separate TNO laboratories were essentially autonomous, with their own individual advisory boards, little central administration, and almost no influence from the government. In the late 1970s, however, Parliament gave the Minister for Science Policy control over the TNO; a steady stream of changes followed.

Under the present structure, TNO is divided into a central administration and eight divisions: Building and Metal Research, Industrial Products and Services, Technology for Society, Technical and Scientific Services, Nutrition and Food Research, Health Research, National Defense Research, and Policy Research and Information. Each division now has a single advisory policy board coordinating the work of the three to 10 laboratories within it. Approximately 600 people are employed in each division, except for the Policy Research and Information Division with only about 100; since TNO's main expenses are for personnel, the overall annual budget of nearly \$200 million is similarly divided among the divisions.

In general, each division receives about two-thirds of its funds from the government, with the balance being contract research for industry. The

health and defense sectors, however, receive all their funds from the government; it is interesting to note that *all* government-funded defense research takes place in TNO laboratories.

The manner of allocating the government funds to the laboratories has very recently been changed in order to give the government more influence in the choice of research conducted; this increases the trend toward central control that was started by the structural changes. No longer does each TNO laboratory have complete discretion over how to spend its government funds. Only 20 percent is now discretionary; the use of the remaining 80 percent must be "discussed with" the sectorial ministries concerned with the subject in an attempt to reach a consensus on the nature of and need for the work to be performed.

Now further changes at TNO are being called for. In February, the Minister for Economic Affairs presented to Parliament the Zegveld Report ("Technology: Towards a Market-Oriented Technology Policy"). The minister agreed with the report that relevant divisions of TNO need to be made "more aware of market needs." TNO was directed to work with small and medium firms on introducing TNO-developed technological innovation into their operations (TNO has not been popular with such firms and tends to work with large ones instead). And it was recommended that TNO be responsive to the Directorate for Technology Policy (see next article) in the Economic Affairs Ministry in investigating how the market can shape the allocation of research funds.

The ZWO

Basic research is beginning to feel some of the same pressures that applied research has experienced in the last several years. When ZWO was established by law in 1950, it was placed under the Minister of Education and Science and charged with promoting and coordinating pure research in all fields of learning and applied research in the social sciences and humanities only. About half of ZWO's roughly \$70 million annual budget goes to support research in universities, and half to research institutes. This contribution to university research is only about 7 percent of university research funding, most of the rest of which comes directly from the government; the ZWO contribution is about 55 percent of the institutes' funding. ZWO awards are made much as are National Science Foundation grants in the US. Nearly half the ZWO budget goes for physics, about 10 percent for chemistry, and about 5 to 8 percent for each of mathematics, social

science, the humanities, astronomy, biology, and medicine. Only about 40 percent of their top-rated proposals are funded; the success rate may fall to nearer one-third next year because of budget constraints.

Until 1981, proposals in various fields competed equally for ZWO support; in that year, priority areas were introduced at the insistence of the ministry. They presently include biotechnology, ethnic minorities, gerontology, computer sciences, meteorology and ocean sciences, scientific instrumentation, and--the newest--surface science. Success rates for proposals in these areas are close to 80 percent; about 4 percent of ZWO funds is "fenced" in this way.

Soon the ZWO will be combined with a younger and smaller sister (the Stichting voor de Technische Wetenschappen, with an annual budget of only about \$4 million) to form a broader natural sciences research organization that will be allowed to fund basic research in applied science as well as in pure science.

Some people are nervous about these recent changes. They worry that the size of the fenced funds for priority areas will grow at the expense of the others, and that the choice of the priority areas will reflect market rather than scientific concerns. And they also fear that basic research in applied science will grow at the expense of that in pure science.

Some of these fears seem justified. The Minister of Education and Science recently proposed a significant further restructuring of ZWO that would greatly increase central control and also place that control in political hands--hands primarily concerned with economic and political considerations. Although such changes in ZWO's enabling legislation would require at least 2 years to implement, the scientific community is a bit uneasy about receiving such signals of coming trends.

The Netherlands has long stood out among other nations in the flexibility it allowed its basic research community in allocating funds. That freedom is rapidly disappearing.

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HOLLAND'S NEW TECHNOLOGY-POLICY GROUP

by James W. Daniel.

The Directorate for Technology Policy within The Netherlands' Ministry

of Economic Affairs was proposed late in 1982, was officially created in the summer of 1983, and by spring 1984 reached nearly full staff with 25 of its intended 30. The directorate is ready to address the problems for which it was created. Yet it remains controversial in Holland's science and technology community, with significant disagreement over whether the directorate is a disaster or stroke of genius. The only clear conclusion is that the directorate's creation reflects a lengthy trend toward market-oriented science policy in The Netherlands (see the preceding articles).

The Directorate

On 15 August 1982 the Minister of Economic Affairs appointed a Technology Policy Project Group to formulate short-term proposals on the content and structure of a market-oriented government technology policy and to advise the minister on how to implement the proposals; Professor W.C.L. Zegveld of the University of Delft chaired the group. Although the Zegveld Report wasn't completed and presented to Parliament until February 1984, the group's early recommendation that the directorate be established was accepted by the cabinet in October 1982. Dr. R.F. de Bruine was named as the director, reporting to the minister through the permanent undersecretary. The directorate was created officially on 1 June 1983 with a target of 25 staff members by spring of 1984; when I visited in May, 25 were in place and the target had increased to 30.

The minister has charged the directorate with promoting, coordinating, and evaluating a market-oriented technology and innovation policy for the government; the charge is to be carried out by four divisions. The first division treats general aspects of technology and innovation policy, with primary emphasis on coordination of efforts among various government ministries and departments. The second division seeks to ensure that government-funded groups--universities, the ZWO and TNO pure and applied research organizations, research centers, and so on--are oriented toward the market. The third treats international aspects of technology policy, including policy relating to cooperation with multinational or foreign national groups; it also analyzes technology policies of other nations. The fourth coordinates policy in special technical areas, such as research and technology for informatics, biotechnology, energy, materials science, space science, marine science,

and traffic and transportation. The primary tool for the directorate will be its new Innovation Stimulation program scheduled to start in October. Through 50-percent tax deductions for industrial R&D, it will pump about \$75 million per year for 5 years into technological innovation--70 percent of it to small and medium businesses. But Director de Bruine observes that there is more to innovation than money: the real need is for good ideas and a market orientation, with the important task being to stimulate people in industry, in research institutes, and in universities. He expects to know in a year whether there has been progress. And the recent publication of the Zegveld Report has certainly focused national attention on the need for progress.

The Zegveld Report

A nearly 40-page English summary of the Zegveld Report, "Technology: Towards a Market-Oriented Technology Policy," is available from the directorate. It observes that The Netherlands' government and industry each contributes about 1 percent (\$1.2 billion) of the gross national product to R&D; the 1.9 percent total compares unfavorably with the more typical 2.5 percent of other industrialized countries. The report argues that the industrial share is the one that should increase, and that this should primarily be through small and medium firms--five companies now provide 70 percent of the industrial R&D funds. And it asserts that universities and research centers must be stimulated toward a more market-oriented outlook in order to assist increased innovation in smaller firms; this stimulation may require tighter controls on the historically very flexibly allocated government funds for R&D.

The Controversy

Proponents of the directorate point to the data and recommendations of the Zegveld Report as justifying the directorate. Staff members told me that the directorate can provide new programs and coordination toward a common goal--technological innovation--that are presently lacking in Dutch R&D. Placing such an effort under the Minister for Economic Affairs will ensure, they feel, the proper market-oriented approach; and the entire Dutch R&D effort will benefit.

Not everyone agrees.

Dr. E. van Spiegel, Director General for Science Policy in the Ministry of Education and Science, feels that "... innovation policy was handed over too soon. The politicians were responsible for that and I find it a

shame." His group had developed innovation-oriented programs, but these--and 15 staff positions--were moved to the new directorate. This means that general R&D policy responsibilities are now divided: science policy in one ministry, technology policy in another. Professor H.V. van Bueren, who heads the RAWB (an advisory council on science policy similar to the US National Science Board), called this a "dreadful split." He fears that the broad general science policy, born in The Netherlands just 12 years ago and now reaching adolescence, is terminally ill. Basic research he expects to suffer as larger shares of a shrinking government R&D budget go to programs the new directorate views as market oriented. And he sees the new shift toward increased management and direction of research as fueling an already overheated furnace of stifling regulations.

Regardless of the controversy, however, the new directorate is well staffed and its major programs are about to begin. In submitting the Zegveld Report to the Dutch Parliament, Economic Affairs Minister G.M.V. van Aardenne wrote: "Developing a market-oriented technology policy is a long-haul process. Not only because many interests are at stake ... but also because long-established structures and even cultural patterns will have to be adjusted or changed." Besides starting its new programs, the Directorate of Technology Policy has to work with those "long-established structures"--some of whom don't want to change.

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THE EUROPEAN SCIENCE FOUNDATION

by James W. Daniel.

As it nears the 10th anniversary of its November 1974 founding, the European Science Foundation (ESF) is expanding into new areas in which it can stimulate cooperative research among member countries. A consortium to join the US National Science Foundation (NSF) in an ocean drilling program and an advisory committee on environmental toxicology are two of the newest programs, joining older ones such as the Space Science Committee and the European Training Program in Brain and Behavior Research (ETPBRR).

Background

The ESF comprises 48 science academies and research councils from 18 countries; "science" is taken to include the social, natural, life, and mathematical sciences as well as the humanities. Headquartered in Strasbourg with a professional scientific staff of eight--headed by Dr. John Goormaghtigh, a political scientist from Belgium--and a support staff of 13, the Foundation has an operating budget of about \$1.25 million, of which about 10 percent is available to support meetings and to plan programs. Contributions to this general budget come from all member countries in proportion to their gross national product. The ESF seeks to increase the world standing of European research primarily through "Additional Activities," whose special budgets are funded by those member organizations that choose to participate. The central staff has an additional budget of about \$1.25 million to coordinate and organize the Additional Activities, whose individual budgets may well total several times that amount. Some "Associated Activities" are managed by the ESF on behalf of other organizations.

Professional staff members are seconded to the ESF from member organizations and are chosen so as to represent both scientific and geographic interests. For example, physics is presently covered by Dr. Klaus Saul from Germany (replaced in July by Dr. Josip Hendekovic from Yugoslavia), brain and behavior research by Dr. Erik Schenk from The Netherlands, materials science by Dr. Jean-Pierre Roth from France, and so on. The staff manages programs that seek:

- To assist member organizations to coordinate programs and define priorities;
- To identify areas--especially interdisciplinary--in need of stimulation;
- To improve cooperation between researchers;
- To assemble data;
- To foster dissemination of information;
- To respond to invitations from other groups aiming to advance European science; and
- To maintain constructive relations with the European Community, US science organizations, and other relevant groups.

The nations represented by member organizations are Austria, Belgium, Denmark, Finland, France, the Federal Republic of Germany, Greece, Ireland, Italy, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey,

the UK, and Yugoslavia. Professor H. Curien from France serves as president, and the vice presidents are Professors R. van Lieshout from The Netherlands and T.D. Spearman from Ireland.

Continuing Programs

Each of the ESF's major disciplinary groups--humanities, social sciences, biomedical sciences, and natural sciences--coordinates a variety of activities, including overall steering committees, Additional or Associated Activities, working groups, and the like. I'll mention here only a few that might be of interest to ESN readers.

One ESF standing committee is that of the European Medical Research Councils, a group of organizations funding biomedical research. Its subcommittees coordinate activities in such areas as toxicology, human reproduction, mental illness, and the extensive ETPBBR brain and behavior program. The ETPBBR seeks to stimulate multidisciplinary research on problems of the brain and behavior, including both neurosciences and psychology. In 1983, over \$200,000 was spent on various ETPBBR grants and training programs, primarily for young research workers. These efforts will shift next January from an Additional Activity to an Associated Activity.

Several ESF projects address areas of the natural sciences. The European Geotraverse Project is an Additional Activity to obtain accurate geomagnetic observations that will contribute to the understanding of the formulation and development of the European continent; this Activity should end in 1988. The Committee on Polymer Science has organized workshops and published such valuable studies as *Polymer Research in Europe: I, Universities and Non-Industrial Laboratories*, and *II, Inventory of Big Facilities and Specialised Laboratories, Techniques, and Methods*. The Space Science Committee provides independent guidance and advice to the European Space Agency, much as does the Space Science Board of the US National Academy of Sciences to NASA. The committee and its US counterpart have together sponsored a series of workshops on collaboration in space science, the most recent of which defined an international program in solar and space physics. And the Working Group on Nuclear Physics recently published *Nuclear Physics in Europe: Present State and Outlook*.

Recent Initiatives

To allow participation in the US NSF's ocean drilling project (ODP), the ESF has established the Working Group on

the ODP as an umbrella organization of members in countries other than France, Germany, and the UK. Total contributions of \$200,000 to the working group allowed its members to participate in planning for the project and its management. The ESF now is seeking to raise \$2.5 million per year for 5 years to allow the working group full regular membership in the project; this would allow scientists from member organizations to perform research aboard the drilling ship.

Just as the preceding project uses the ESF as a coordinating agency to represent member organizations to an external group (the NSF, in that case), the Working Group on Environmental Toxicology provides unified and independent scientific advice to the Commission of the European Community (EC) on which to base its directives on controversial environmental issues. Upon working group recommendation, the ESF hired Professor A. Van der Gen and Dr. K.R. Krijgsheld from the University of Leiden, The Netherlands, to conduct a pilot study (restricted to chlorophenols, chloropropenes, and epichlorohydrin) of the literature, data sources, controversies, research approaches, and so on concerning the environmental impact of toxic chemicals. The working group will use this study to prepare its October 1984 report to the EC Commission on how to proceed with a European effort on this important problem.

Following a 1982 decision, the ESF is now exploring expanded efforts in the general area of engineering sciences. Two 1984 workshops in this area include one on distributed computing systems and one on computer recognition of objects ("computer vision"). Secretary-General Goormaghtigh expects activities in these areas to increase.

Conclusion

How successful has the ESF been? How successful can it be? How successful will it be? ESF's Vice President Spearman wrote about ESF's founding and future in the spring 1984 *ESF Communications*: "Hopes were high that ... basic research in Europe could be restored to a position of world leadership.... Ten years on, the actual achievement ... must seem modest. Objective judgement would say that the case for European collaboration in basic science ... is even more obvious today than it was ten years ago. And yet the mood now is less favourable.... In a difficult economic situation basic research is afforded reduced priority, and collaborative projects are often seen as additional luxuries. The achievements

of the Foundation are nevertheless not negligible.... [W]hen enumerating our achievements we should also lay emphasis on the progress which has been made in developing effective structures.... These form the practical measure of what we can do, now and in the future. The extent to which this potential is exploited will depend on ... recognition ... of the benefit of co-ordinated policy and collaborative action.... Not every area of research needs multinational collaboration.... But there are many fields where it is essential ... if the European work is to match that which can be achieved in the United States.... [P]roviding guidelines for co-ordinating ... national programmes ... must be worthwhile, indeed it is surely necessary,... if we are to share and succeed in a common European objective."

This long quotation clearly reveals the European aspect of the ESF, the wish to provide a broader-based research effort comparable to that in the US. It equally clearly reveals the problems facing the ESF in this effort. The ESF has had its successes and is a valuable organization; but Spearman's goal of matching US science through ESF coordination isn't yet within the ESF's grasp.

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SPACE SCIENCE

ITALY'S ARCETRI ASTROPHYSICS OBSERVATORY

by R.L. Carovillano. Dr. Carovillano, formerly at ONR, London, is Professor of Physics at Boston College.

Research at the Osservatorio Astrofisico di Arcetri (the Arcetri Astrophysical Observatory) in Florence, Italy, includes infrared and radio astronomy, solar physics, satellite-related programs, and collaborative efforts with other European and US institutions. Founded in 1872, Arcetri is an independent institute of the Italian Ministry of Education. It is on a hill overlooking the city and is a short distance from the villa where Galileo spent his final years after being exiled by the Pope. (Galileo's residence is being restored as a national monument and will soon be used for small scientific conferences and meetings.)

Professor Franco Pacini is director of the observatory and is well placed on

important committees that decide upon Italian research priorities and funding in astronomy. About 77 people work at the observatory. Seventeen senior astronomers, 20 additional scientists, seven support personnel, and nine administrators are on the Arcetri staff; another eight astronomers, 10 faculty members, and six support staff members are assigned to the observatory by the Italian National Research Council (CNR) or the University of Florence. For 1983, the observatory budget amounted to about \$47 million. The Ministry of Education provided \$27 million, the CNR \$14 million, and the local region of Tuscany about \$6 million.

In 1983, Arcetri scientists authored and co-authored about 75 papers published or accepted in leading journals. All journal publications are in English to assure the widest possible readership and accessibility. Observatory scientists who published several papers include the following: Marcello Felli (infrared and radio emissions from circumstellar ionized regions, star formation, high-spatial-resolution observations in the near infrared); Franca Chiuderi-Drago (microwave, ultraviolet, and soft x-ray observations, nonthermal radio sources); Massimo Landini (x-ray and extreme ultraviolet [EUV] emissions; stellar transition region and coronal emissions, observations and models); Franco Pacini (role of magnetic fields in stellar collapse, luminosity of fast pulsars, supernova studies); Roberto Pallavicini (modeling of Solar Maximum Mission [SMM] observations, magnetic field configuration of flare filaments, cool stars); Giannina Poletto (two-ribbon flare theory, reconnection theory; energy in the solar transition region).

Radio Astronomy

Italy's first radio-astronomy program began at Arcetri in the 1950s when Guglielmo Righini was director. Initially, radio studies of the sun were made using the Arcetri radio telescope. Today, observational programs are carried out on some of the world's great radio telescopes in programs that include collaborations and extensive use of facilities at Arecibo, Bonn, the very large array, and Westerbork. Studies are made on topics such as solar phenomena, diffuse matter in space, molecular clouds, galactic hydrogen, and stellar winds. Jointly with the Institute of Radio Astronomy in Bologna, Arcetri is developing two 32-m antennas for very long baseline interferometer (VLBI) research. One antenna is near Bologna, and the other (to be completed in 1985) is about 700 miles away in Sicily. Arcetri

developed acoustic-optical correlators, microwave components, and computerized control of the telescopes. Future VLBI studies at Arcetri will be on galactic topics such as stellar masers, molecular clouds, and compact stellar objects.

Infrared Astronomy

The Arcetri staff is complemented in this area by the CNR Center for Infrared Astronomy and Studies of the Interstellar Medium located at the observatory. In a joint effort, Arcetri and its CNR Center operate the 1.5-m infrared (IR) telescope, a national facility located in the Swiss Alps on the Gornergrat (3200 m). IR observations at Gornergrat are made in the wavelength range 1.2 μm to 25 μm and in the submillimeter region. A near-IR spectrometer will be operational soon, and development of an optical photometer and a charge-coupled-device system is planned. Research at Gornergrat is in areas such as photometry and broad-band spectroscopy of stars and stellar winds, variability of extragalactic objects, and photometry of galaxies.

Other Arcetri IR programs are a collaboration with Cornell University using the Kuiper Airborne Observatory and participation in the development of the Infrared Space Observatory (ISO). In 1983, ISO was chosen by the European Space Agency as its next mission (see the next article and ESN 35-7:187 [1983] for further information on ISO).

Solar Physics

Arcetri has been active in solar physics research for more than 60 years. The solar tower at Arcetri was erected in the 1920s with the advice of G.E. Hale and is equipped with a vertical spectrograph and a tunable Fabry-Perot interferometer to measure line profiles with high spectral resolution and photometric accuracy. Solar velocity fields with an uncertainty of ± 2 m/s can be inferred from the data. Other solar research is on active photospheric regions, flares, coronal holes, solar activity, and magnetic field-plasma interactions. Arcetri solar astronomers carry out both ground-based and space research in collaboration with foreign colleagues.

Other Programs and Facilities

Other Arcetri observational programs and outside collaborations are in optical, ultraviolet, and x-ray astronomy. Satellite research in these areas dates back to Skylab in 1973-74, and Arcetri astronomers have been co-investigators on the more recent missions

Einstein, International Ultraviolet Explorer, SMM, and EXOSAT. Collaborative research is carried on with several institutions, including the US Naval Research Laboratory, Harvard University, the University of California, the Observatoire de Meudon, and the Utrecht Observatory.

In a recently approved national project, Arcetri is participating in building a 3.5-m optical telescope that will be completed in the late 1980s.

Computer facilities at Arcetri include a VAX 11/750, several smaller computers, and a direct link with large national computing centers.

Theoretical research is done on a wide variety of astrophysical topics, including the interstellar medium, star formation, fundamental plasma processes, spectroscopy and polarimetry of high-temperature gases, solar and stellar atmospheres, flares, and high-energy astrophysics.

Arcetri conducts an active in-house colloquium series, meeting essentially weekly during the academic year. Speakers come from other Italian institutions, but also many European and US institutions. Arcetri scientists in turn are active in giving colloquia on their research at other institutions.

Arcetri hosts a large number of foreign visitors each year, including visiting scientists, post-doctoral fellows, and graduate students. The observatory also conducts a popular in-house program on astronomy for school-age children and the general public. These activities attract more than 5000 guests annually.

5/22/84

THE INFRARED SPACE OBSERVATORY

by H.A. Smith and R.L. Carovillano. Dr. Smith is an astrophysicist at the Naval Research Laboratory in Washington, DC. He specializes in infrared device development and the physics of star formation. Dr. Carovillano, formerly at ONR, London, is Professor of Physics at Boston College.

Infrared (IR) astronomy began less than two decades ago with the advent of sensitive cryogenic detectors. Since then, IR discoveries have greatly revised our picture of the universe. Many of the most intense sources of radiation in the sky are invisible to

the eye but are strong emitters of IR radiation, whose wavelength range extends from 1 μm to about 1 mm. These sources include cool stars, nebulae of hot gas around stars, vast clouds of cool dust and gas floating in interstellar space, galaxies, and many objects whose nature is uncertain, such as those at the center of our own galaxy, the Milky Way.

IR astronomy also provides unique and crucial information on the familiar optical sky of planets, stars, nebulae, and galaxies, because these objects also emit IR radiation from regions of low temperature or low excitation energy. One can also study in IR certain remote objects that resemble familiar ones but are actually inaccessible to optical astronomy because of the copious interstellar dust that blocks visible light. For example, IR is the principal means to observe galactic sources much further than about a few thousand light-years (ly) away (the Milky Way is about 30,000 ly in radius).

Because of atmospheric absorption over large portions of the infrared spectrum, airplanes and balloons with telescopes have been used in IR research, and several rocket surveys have been flown. (For a report on the proposed air-borne IR European research program, see ESN 38-2:107-110 [1984].) The most dramatic IR results have come during this past year from the Infrared Astronomy Satellite (IRAS), a joint mission of the US National Aeronautics and Space Administration (NASA), The Netherlands, and the UK. IRAS's orbiting cryogenic telescope found hundreds of thousands of new IR sources, including galaxies seen only in the IR, new comets and asteroids, bands of dust between Mars and Jupiter orbiting about the sun, stars in formation, and possible planetary rings of material around stars.

During its 10-month operational lifetime, IRAS attempted an all-sky survey with instruments dedicated principally to broad-wavelength-band photometry. At the end of the mission, 95 percent of the sky had been scanned at least four times and 72 percent at least six times at four IR wavelengths with unprecedented sensitivity. In the wake of IRAS's success, the European Space Agency (ESA) has proposed the mission known as the Infrared Space Observatory (ISO) that has an IR telescope with a complement of IR instruments, including spectrometers. A roughly similar concept is being considered by NASA under the name SIRTf (Shuttle IR Telescope Facility). ISO was chosen by ESA in March 1983 as its

next space mission (see ESN 37-5:187-189 [1983]).

ISO includes a cooled 0.6-m-diameter telescope in a three-axis stabilized spacecraft. The telescope and scientific instruments, cooled by a dual cryogenic system using superfluid helium and liquid hydrogen, have an expected cryogenic lifetime of at least 14 years. The model instrument payload consists of a near-IR camera, a multiband photometer, and one or two spectrometers with spectral resolving powers ($\lambda/\Delta\lambda$) up to 10^5 . The size, lifetime, and cooling of ISO will permit the study of objects at 80 μm , for example, that are 10,000 or more times fainter than seen even in the IRAS survey. In addition, ISO instruments would be capable of determining spectral character, kinematics, and species abundances. ISO is planned as an observatory open to the whole scientific community, operating as much as possible in "real time." Investigators from a host of European institutions will be involved in developing instruments and proposing experiments for the mission. For example, the astronomy group at University College, London, headed by Professor W. Glencross, is collaborating in a spectrometer proposal with the IR astrophysics group, headed by Dr. Howard Smith, at the Naval Research Laboratory in Washington, DC. The instrument under development is a cryogenic Fabry-Perot imaging spectrometer, which has been supported in part by the Defense Advanced Research Projects Agency in the US. The interferometer operates at low temperature and uses a unique optical servo-control and electromagnetic displacement coil drivers to obtain both flexibility in setting resolution and wavelength, and reliability for automated, remote operation. System concepts are presently being refined with a prototype that operates in the 4- to 10- μm region from ground-based telescopes. A CID array mounted at the instrument output gives imaging capability to the spectrometer.

Science Objectives

Among the objects of the solar system, the giant planets, asteroids, and comets are of special interest since they are thought to contain information that relates to the condition of the primordial solar nebula. The IR range is well suited to study these objects because most of them are cold and thus radiate primarily in the IR. Planetary atmospheres contain molecules such as CH_4 , NH_3 , H_2O and their isotopic variants, which all have spectral signatures in the IR. An ISO spectrometer could

observe the organic and prebiotic molecules found in the atmospheres of Jupiter, Saturn, and Titan, and could study the composition of the atmospheres of Uranus and Neptune and the coma of comets. The dramatic space flyby experiments of the Voyager missions, while making many exciting discoveries, used a spectrometer (IRIS) with only limited resolution and spectral coverage compared to that planned for the ISO.

A major area of inquiry for ISO will be how stars and planetary systems form. IR observations to date have shown that star formation occurs almost exclusively in clouds of molecular gas and dust of proper density and temperature to permit gravitational collapse. Such clouds are highly opaque to visible radiation. The details of the processes that initiate and form the stars, and then disperse the cloud, are still obscure. For example, in triggering cloud compression, the comparative role of spiral density waves versus supernovae shock fronts is not clear. Other questions are what determines the formation of high- or low-mass stars, and what determines the presence of preplanetary material. Both cold, ambient material and excited, warm gas emit strong IR atomic or molecular lines whose intensities and shapes will reveal the internal processes of the clouds. ISO experiments will be able to determine the temperature and composition of such star-formation regions, the kinematics of flows associated with young stars, and certain ionization properties of stars.

A very active form of star formation is thought to power the copious IR radiation emitted by certain peculiar galaxies. In proceeding across giant regions of such galaxies, the process of star formation heats the dust present and produces a spectrum for the galaxy as a whole that peaks around 100 μm . What triggers such activity (if the hypothesis is correct) is unknown. IRAS has discovered very bright galaxies in the IR, with no visible or other wavelength counterpart, that may be even more extreme examples of the already extreme star-formation behavior. Compact nuclei of galaxies, including the nucleus of our own galaxy, also produce intense continuum IR radiation, along with strong atomic emission lines excited by ionizing ultraviolet radiation associated with the nuclear sources. Some researchers have proposed that a black hole is situated in the center of the galaxy, and infalling material produces the energy that heats the dust and ionizes the atoms. ISO will be able to map and spectrally examine both exotic,

active galaxies and normal galaxies for line-emission characteristics of star formation or other physical conditions, and will be able to determine the temperatures, spectral shapes, and total energetics involved.

As ISO observes more and more distant galaxies, it looks back to earlier and earlier stages in the evolution of the universe. The epoch when galaxies first formed is thought by some to have an enormous redshift parameter ($z \approx 5-10$) corresponding to distances greater than 10^{10} ly. These young galaxies should be very intense in the IR because most of their mass would be gaseous, and star formation rates would be high. Such distances and galaxies have not been observed to date, and their discovery by ISO would be fundamental to cosmology. ISO will also be able to detect redshifted atomic lines in distant quasars. A comparison of such data with optical studies of nearby quasars would provide information about physical differences in near and remote quasars, and the degree of constancy of some fundamental atomic constants.

In summary, the ISO mission will extend the existing sensitivity, wavelength coverage, and spectral resolution of current astronomical observations and will have a dramatic impact on just about every area of astrophysics. ISO will also have a built-in flexibility to address scientific issues or questions not yet formulated but which will undoubtedly arise in the next decade during mission development or in flight.

5/16/84

TECHNOLOGY

FRANCE'S ECA IS MAJOR PRODUCER OF REMOTELY OPERATED UNDERWATER VEHICLES

by Chester McKinney. Dr. McKinney is the Liaison Scientist for Underwater Acoustics in Europe and the Middle East for the Office of Naval Research's London Branch Office. He is on leave until September 1984 from The University of Texas at Austin, where he is Senior Research Scientist at Applied Research Laboratories.

Although humans have long explored and exploited the oceans, they remain an alien and hostile environment. As one

moves downward from the air-sea interface the hydrostatic pressure increases, the temperature drops, and the natural visibility decreases. Communication via electromagnetic waves (e.g., radio and radar) is difficult at best. Scuba divers can make only brief excursions to depths of more than about 30 m. Submarines, both naval and civilian, allow diving and working at greater depths; but the costs of life-support equipment in terms of money, space, and weight are very high and often limit the depth, duration, and nature of the underwater work.

This situation has prompted the development of unmanned remotely operated vehicles (ROVs) for both observation (remote sensing) and for performing tasks (robotics). The history of this development is a long one, but much of the progress has been made in the last one or two decades. Major customers have been (and are) the offshore oil business, navies, and oceanographic research groups. More than 200 different designs must have been built by this time, with a much smaller number evolving into production-line items. Most of the ROVs are small submersibles with a tether line running from the vehicle to a parent (control) surface platform. The tether carries command and control signals from the human operator to the submersible and in the reverse direction carries sensor information, usually in the form of television, sonar, and vehicle performance measurements (e.g., heading, depth, and speed). The most common form of propulsion is conventional propellers driven by electric motors. For some the electric power is obtained from batteries in the vehicles, and for others the power is sent from the surface platform through the tether. Each method has obvious advantages and disadvantages, and the choice is largely determined by the particular mission of the ROV. For work other than remote sensing the vehicles are usually fitted with one or more robotic arms, which vary widely in complexity, again depending on the specific task to be performed.

If number of units sold and international acceptance are valid measures of success, then the PAP-104, produced by Soci  t   ECA, France, is the current front-place runner, with no close competition. The PAP-104 (for Poisson Auto-Propulse) is a wire-guided ROV for target identification and seabed disposal, of which a total of 250 units had been sold to 10 navies by the end of 1983. These numbers give substance to the claim by ECA that it is the world's

largest manufacturer of underwater automated systems. (Producers of wire-guided torpedoes might challenge the claim.)

ECA is a small French company with headquarters in Meudon-Bellevue (near Paris), two production plants near Paris, and an R&D facility in Toulon. Of its 300 employees, about half are in production work and half in research, development, service, testing, and sales. The company has been in business for less than 15 years. The PAP-104, also designated the ECA 38, was developed in conjunction with the French government laboratory Groupe d'Études Sous-Marines de l'Atlantique (GESMA) at Brest. It has been in production more than 10 years, and the newest version, the MK-IV, is now on the market with the MK-V under development.

The system and operational concept for the PAP-104 is as follows. A surface craft searches an area with a high-resolution sonar. Water depths typically are less than 100 m. Targets detected are then studied with a very-high-resolution classification sonar. If a target is classified as mine-like, on the basis of the crude acoustic image of the target and its shadow (size and shape), the ship hovers, the PAP is placed in the water, and it sinks until a weighted drag rope rests on the bottom. The ROV, now a few meters above the bottom, is vectored toward the target to be investigated. When it gets within the sonar field of view, the sonar operator vectors it to the target. (The ROV is equipped with a sonar transponder beacon for easy identification.) As the vehicle closes on the target, its TV system is used for final approach and for target identification. If the target is a mine, the vehicle is commanded to drop an explosive charge close to the mine, generally within 2 m. At this point the vehicle is commanded to cut loose from the drag rope; it rises to the surface and is vectored back to the ship for retrieval. The mine destruction charge is actuated by the shock wave from a hand grenade tossed into the water. The charge (90 kg of aluminum tolite) is generally adequate to cause a high-order sympathetic detonation of the mine. If the visibility of the water is too poor to use the TV, the sonar operator, dispensing with target identification, drops the charge when the target echo and beacon (ROV) echo coincide. If the target is classified as a moored mine, rather than a ground mine, the PAP charge is replaced with a cable cutter. The vehicle homes on the cable and attaches a cutter to the tether wire. The ROV then is directed

to return to the ship. Twenty minutes later a small explosive shaped charge actuates and severs the mooring line of the mine.

The PAP-104 ROV is shaped like a miniature submarine and is 2.7-m long, 1.2-m wide, and 1.3-m high. It weighs 700 kg in air, including the charge package of 127 kg. The battery is a conventional lead-acid type of 32 V and 145-Ah capacity. Propulsion is by two horizontal-thrust electric motors, one on each side, driving constant-speed, variable-pitch propellers. Nominal speed is 5 knots, and the vehicle can do five 20-minute operations between battery chargings. The maximum depth of the earlier models was 120 m because of the type of motor used. The new MK-IV is equipped with brushless motors which use variable-frequency electronic commutation. These drive variable-speed, constant-pitch propellers. The motor operates in a liquid which is at ambient water pressure. The depth limit of the MK-IV is 300 m. The vehicle is equipped with a gyro compass for heading information. The coaxial tether cable is 1000-m long and 3.0 mm in diameter. It feeds out from a bobbin on top of the vehicle. It is nonbuoyant and lies on the bottom as the vehicle proceeds. The drag weight is 30 kg. Vehicle height above the bottom is determined by the length of the rope between the vehicle and this weight. The identification sensor is a closed circuit black-and-white TV with a bandwidth of about 1.0 MHz. The image quality is only fair but is adequate for the task. A searchlight is also installed. As an option the MK-IV can be equipped with a very-high-resolution identification sonar instead of the TV. ECA literature mentions the Krupp Atlas nearfield sonar, which is an expensive unit. I suspect that other, less expensive, commercial sonars can be furnished also. The MK-V, under development, will be able to carry both a TV (a low-light-level, high-resolution unit) and a sonar. The rest of the PAP system consists of a small operator's console and TV monitor, a crane for launch and recovery, and a cradle for deck stowage. Normally a ship carries two vehicles.

The PAP-104 has been very successful. It is simple, reliable, relatively inexpensive, and it does the job for which it was designed. The cost is always a function of many factors, including options and quantity. The price is about \$1.4 million for a complete system (two vehicles), with extra vehicles being about \$400,000 each. ECA continues to make improvements and estimates that their total

market may reach 500 units. For more than 10 years it has had a virtual monopoly in this field, but several competitors are now coming on the market. These include the Messerschmitt-Bölkow-Blohm/Vereinigte Flugtechnische Werke (West Germany) PINGUIN B3, the SMIN Consortium (Italy) MIN, the Gaymarine (Italy) PLUTO, the Honeywell (US) MNS, and perhaps others. Most of these (excluding PLUTO) are more complex and costly than PAP. It will be interesting to see how these various ROVs fare, both in terms of operation and sales.

In addition to PAP-104, ECA has developed and built several other underwater ROVs. EPAULARD ("killer whale") is perhaps the best known of these. It was built to the specifications of Centre National d'Exploitation des Océans (CNEXO). This ROV is untethered but receives command and control signals by an acoustic link. The primary mission is to make bathymetric and photographic surveys to depths of 6000 m. The submersible is 4-m long, 2-m high, and 1.1-m wide, and weighs 2.9 tons in air. It travels at a speed of 1.0 m/s and has an endurance of about 8 hours. This allows it to make a survey about 12-miles long on each mission. Depths and topographic data are recorded on magnetic tape, and still photographs are taken every 5 to 10 seconds. It has been operated by CNEXO in the Atlantic, Pacific, and Mediterranean. The ROV is tracked acoustically by the parent ship. As with PAP, a drag rope is used to maintain a constant height above bottom. However, the height is measured also with an echo sounder, which, in combination with the hydrostatic pressure measurement, yields the bathymetric data.

Poisson d'Observation en Pleine Eau (POPE) is a tethered ROV intended primarily for underwater inspection tasks, such as offshore oil operations. It is similar in size to PAP (2.2×1.0×0.9 m; weight, 400 kg), but electric power is sent down the tether line. The sensor is a high-quality TV with pan, tilt, and zoom capabilities. Maximum operating depth is 150 m, and the buoyant tether is 400-m long. Options include a sonar and a still camera.

A fourth ECA ROV is a scale model of a full-size submarine. It is used to make hydrodynamic tests.

ECA has demonstrated that there is a market for underwater ROVs provided one produces simple, rugged, reliable devices that are competitively priced, and that perform a needed function. The primary customers mentioned earlier have identified well-defined needs, and

advances in technology have allowed practical solutions. The ROVs just described, and most other present units, must be judged as primitive in comparison to possible future devices. Typically at present operators receive sensor information and direct the ROV to perform certain tasks. There is little artificial intelligence in the systems, but this will surely change. The interim step will be for the ROV to perform more signal processing and present the operators with reduced data. Some systems have demonstrated this type of operation. Ultimately one would like to program an ROV to conduct a given mission. The ROV would proceed, collect sensor information, process it, make decisions, perform the tasks based on these decisions, and return home to give a full report on its activities. This level of sophistication remains in the future. And certain basic limitations (e.g., self-contained power supplies and communications bandwidth) will remain and must be coped with. The oceans remain alien and hostile.

5/24/84

NEWS & NOTES

NEW SCIENTIST SAYS, "BRITAIN MISSED BIOTECHNOLOGY BOAT"

According to an article in the 22 March 1984 issue of the *New Scientist*, British industry lacked the foresight 5 years ago to invest in what appeared to be the unknown market for biotechnology equipment. As a result, a current assessment shows that Britain is far behind other countries in the European Community, the US, and Japan in the production of equipment for the biotechnology industry.

The British Department of Trade and Industry (DTI) has commissioned Matthew Hall Norcain (MHN) Engineering to conduct an intensive study of British suppliers of biotechnology equipment. According to the *New Scientist* article, the study, which will be published in 31 parts, is looking at equipment for every stage of the "downstream process"--in other words, the parts of the biotechnology process that take place after fermentation. The report will cover filters, pumps and pipes, safety cabinets, purification columns--everything, in fact, from hoses to computer control to the minute valves and seals that

ensure the air-tight sterility so important to biotechnology processing.

MHN Engineering has found that although there are British companies in almost every equipment sector, they cannot match foreign competition in price, delivery, and service. The *New Scientist* goes on to quote Dr. John Richards, MHN's research and development manager, "There is a general unawareness of what is needed for this industry. Although we have the necessary engineering skills and technology, British companies are unwilling to spend R&D money developing their own products."

The report will show that in two crucial areas--centrifuges and purification columns--foreign competition is far ahead of Britain. At present, there are no British companies manufacturing centrifuges. Sweden and West Germany have the lead in this area. Pharmacia, of Sweden, dominates the purification-column technology and has developed a new generation of fast-flow sepharose gels that process protein liquors at a much higher rate than traditional columns. However, BioIsolates, a small British firm, hopes to challenge Pharmacia with a new and different technology. In most other areas, it is believed that the gaps are not insurmountable and with concerted effort can be closed.

The DTI had already realized that British companies need to be pushed toward the lucrative biotechnology market. In July 1983 they set up a joint collaborative R&D project called Biosep. The project is aimed at developing industrial techniques for processing after fermentation and is costing the DTI between £1 million and £2 million. If the industry responds as expected, it will be selling to a market prepared to spend £85 million in the UK on equipment and expertise. (Note: £1.00 = \$1.40 at current exchange rate.)

Thomas C. Rozzell
5/15/84

PLASMA FURNACES FOR STEEL MAKING

Voest Alpine AG, an Austrian steel-making firm, has built a 45-ton plasma furnace that uses an argon gas plasma to convert scrap iron to steel, according to the *International Herald-Tribune* (London, 27 April 1984). Voest Alpine claims that this furnace will produce higher quality steel for less cost than the electric arc furnace commonly used for the production of

high-quality steel. Melting in the inert argon environment instead of air reduces the oxidation of iron and the alloying elements; the result is a steel that is cleaner (fewer oxide inclusions) and less expensive (lesser alloying element loss due to oxidation).

The use of the plasma furnace in steel making is new in the Western world, but East Germany has produced over 600,000 tons of steel by this process. (Voest Alpine has licensed the technology from East Germany.)

In the US, Westinghouse, in conjunction with the State of Minnesota, is building a plasma furnace at Hibbing that will be used to convert iron ore to iron. The fact that the plasma-furnace process for reducing iron ore to iron uses coal instead of coke makes it more attractive to locate the furnace at the source of the coal, reducing transportation costs.

Kenneth D. Challenger
5/10/84

CAMBRIDGE HIRES MATERIALS-DEPARTMENT HEAD

Derek Hull is Cambridge University's new head of the Metallurgy and Materials Science Department. Since 1964, Hull has been head of the Metallurgy and Materials Science Department at Liverpool University.

At Cambridge he replaces Professor R.W.K. Honeycombe, FRS. Honeycombe has taken early retirement after 18 years as head of the department at Cambridge.

Kenneth D. Challenger
5/25/84

NEW INTERNATIONAL EMPHASIS FOR AMERICAN EDUCATIONAL RESEARCH

The American Educational Research Association is the principal scientific and professional association for educational research in the US and Canada. Its membership includes investigators from all of the behavioral and social science disciplines relevant to educational research, including psychology, sociology, anthropology, linguistics, economics, and history, as well as individuals working on the development, dissemination, and use of research in

education. There are sections on military and industrial training and instruction, as well as on public school education at all levels. The number of foreign affiliate members, especially from Western Europe, Latin America, Israel, and Japan, has been increasing in recent years.

At its most recent annual convention, from 23 through 27 April 1984 in New Orleans, President-Elect David Berliner announced that the focus of the 1986 convention will be on international liaison. An attempt will be made to bring in representative educational research from many other countries. Invited speakers and symposia will also address this theme.

Questions, ideas, and requests for further information should be addressed to:

Prof. David Berliner
AERA President-Elect
Department of Educational
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University of Arizona
Tucson, AZ 85721

or

Prof. Richard Shavelson
1986 AERA Program Chair
Dept. of Educational
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UCLA
Los Angeles, CA 90024

Richard E. Snow
5/1/84

LEISURE STUDIES: A NEW JOURNAL

The Leisure Studies Association has begun publishing a journal and a series of books covering behavioral and social science research on a wide range of leisure behavior in the arts, sports, cultural activities, tourism, and urban and rural recreation. The editorial board is international, as is the planned content. Examples of recent journal article titles include: Measuring Intrinsic Motivation in Everyday Life; Towards a Social Psychology of Recreational Travel; Adolescent Perceptions of Work and Leisure; Work, Unemployment, and Leisure; Leisure and Social Theory; Do National Parks Have a Future in Africa?; Leisure and the Family in Contemporary France; Ideology, Politics, and Sport in Egypt; Holiday-Taking and Socio-Economic Status in Australia; The Contribution of Economics to the Study of Leisure; Sex Differences

in Recreational Sport Behavior and Attitudes: A Study of Married Couples in Israel. Book titles include: Recreation Site Survey Manual; Recreation Planning and Management Issues.

The editor for 1984 is John Roberts. Subscription and purchase information can be obtained from: Associated Book Publishers (UK) Ltd., North Way, Andover, Hampshire SP10 5BE, UK.

Richard E. Snow
5/2/84

NEW STUDIES EXAMINE INDUSTRIAL R&D IN UK

Two new British studies examine attitudes toward R&D and technology in industry.

How Companies Manage R and D: A Survey of Major UK Companies assesses the techniques used to manage industrial R&D--especially the processes used to choose projects, to conduct in-progress evaluations of projects, and to stop projects.

According to *The Financial Times* (London, 16 April 1984), the study found that UK research managers are reluctant to close projects, even when ordered to do so. The managers usually find ways to keep a project going--often because someone in top management is willing to support it.

The study found "an apparent lack of interest, even commitment to R and D at main board level" in many of the companies. Moreover, R&D managers often do not know their company's strategic aims and therefore choose "projects which interest them rather than projects which fit the strategy."

How Companies Manage R and D: A Survey of Major UK Companies, by Niall Lothian, is published by the Institute of Cost and Management Accountants, 63 Portland Place, London W1N 4AB.

Another study, *Attitudes To New Technology*, found that British businessmen are confident of the technological superiority of their products, according to *The Economist* (5-11 May 1984). But these businessmen make little use of advanced technology. For the survey, 513 businessmen from the US, Australia, Belgium, the UK, and West Germany were interviewed.

The Economist notes that UK, West German, and Belgian firms are proud of their technology. About 50 percent of the British executives interviewed said that their products were the most

advanced in their field, compared with 40 percent of the Americans and 30 percent of the Australians. But only 18 percent of the British said that the new technology had a great impact on their products, compared with 45 percent of West Germans and 42 percent of Americans.

On production processes, 16 percent of the British thought advanced technology had made a big impact, and half said it had made little or no impact. Over 25 percent of the British firms had made no significant change in their production processes in the past 5 years. But 37 percent of the Belgians and 34 percent of the Americans and West Germans thought the new technology had had a big effect on production processes.

Companies tend to place most emphasis on R&D for improving existing products, rather than on production processes, new products, or fundamental research, according to *The Economist's* review.

Attitudes To New Technology is available from MORI, 32 Old Queen Street, London SW1.

Larry E. Shaffer
5/11/84

ASTRONOMY MEETING PROCEEDINGS PUBLISHED

The proceedings of the seventh European Regional Astronomy Meeting have been published in a special volume on behalf of the Italian Astronomical Society (IAS). The meeting took place from 12 through 16 December 1983 in Florence, Italy (ESN 38-4:218 [1984]). Only regular issues of the IAS journal are available to the IAS membership free of charge. Inquiries and orders for the proceedings may be directed to:

Segreteria
Italian Astronomical Society
Largo Fermi 5
50125 Firenze
ITALY

R.L. Carovillano
5/22/84

NAPLES SPACELAB SYMPOSIUM

The International Symposium, Spacelab: Results, Implications, and Perspectives was held in Naples and Capri from 11 through 16 June 1984.

The heart of the symposium was the Spacelab-1 Investigators Working Group Meeting. Full days were devoted to presentations in the major scientific areas addressed by Spacelab-1: space plasma physics; materials, fluid, and life sciences; and astronomy, solar physics, atmospheric physics, and earth observations. The symposium included a second forum--Space System: Utilizations and Their Legal/Economic Aspects.

In addition, the symposium emphasized the benefits of international cooperation and looked forward to possible collaborations between Europe and the US.

Professor Luigi G. Napolitano of the University of Naples--re-elected president of the European Low Gravity Research Association--will prepare the proceedings of the symposium for publication; they may be obtained by writing to:

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Later this year, the symposium will be the topic of an article in *ESN* by Dr. Kenneth Challenger, Liaison Scientist for Materials Science at ONR, London.

R.L. Carovillano
5/23/84

ASTROPHYSICS AND SPACE-PLASMA COURSE AND WORKSHOP

A course and workshop on astrophysical and space plasmas will be held from 28 August through 7 September 1984 at the Villa Monastero, in Varenna, Italy. The program directors are B. Coppi and B. Rossi (Massachusetts Institute of Technology), A.A. Galeev and V.N. Tsytovich (USSR Academy of Sciences), and R. Pellat (École Polytechnique, France). The program is offered under the auspices of the International School of Plasma Physics, which P. Caldirola (University of Milan) directs.

Topics of the course extend from solar system to intergalactic considerations and include the following: the solar wind and the heliosphere, planetary magnetospheres, acceleration processes at the sun, magnetic reconnection, shock waves, relativistic plasmas,

origin of cosmic rays, galactic plasma emission processes, stellar dynamics, galactic jets, macroscopic galactic plasma processes, optical astronomy, cosmology, formation of galaxies, pulsars, x-ray astronomy, accretion, and nonlinear plasma processes.

The workshop will focus on selected topics from the course and will emphasize recent theoretical results and experimental observations in plasma astrophysics. Workshop participants will have the opportunity to contribute papers.

The school and workshop are cosponsored by local agencies, the University of Milan, the Italian National Research Council, and the European Space Agency (ESA). The proceedings will be published in November 1984 as ESA Special Publication SP-207. Inquiries about the proceedings may be directed to:

ESA Scientific & Technical
Publications Branch
P.O. Box 299
Noordwijk
THE NETHERLANDS

R.L. Carovillano
5/17/84

INTERNATIONAL ASTRONAUTICAL CONGRESS MEETING ON SPACE BENEFITS FOR ALL NATIONS

The 35th International Astronautical Congress will meet from 7 through 13 October 1984 in Lausanne, Switzerland. "Space Benefits for All Nations" is the theme of the meeting. The Congress is jointly sponsored by the International Astronautical Federation (IAF), the International Academy of Astronautics (IAA), and the International Institute of Space Law (IISL). The host agency is the Swiss Association for Space Technology.

The Congress will consist of a large number of symposia relating to virtually all aspects of space exploration and development. More than 35 nations will be represented through societies affiliated with the sponsoring agencies. Symposia topics and coordinators are as follows:

- Symposium on Space Transportation Systems, V. Plokhikh (Intercosmos Council, USSR Academy of Sciences) and R. Salkeld (Systems Development Corp., CA). Sessions will be held on "Low Earth Orbit and Return," "Beyond Low Earth Orbit," and "Transport Support Operations."

- Symposium on Space Stations and Space Platforms, R. Freitag (Space Station Task Force, NASA Headquarters, Washington, DC) and R. Mory (European Space Agency [ESA], Paris). Session titles are "Design," "Technologies," "Operations," and "Utilization."
- Symposium on Communications, P. Bargellini (COMSAT Laboratories, Clarksburg, MD) and E.S. Mallett (ESA, Paris). Session titles are "Technology," "Broadcasting and Data Gathering," "Fixed Service," and "Mobile Service."
- Symposium on Earth Observations From Space and Earth Environment, D.N. Mishev (Central Laboratory for Space Research, Sofia, Bulgaria) and W.M. Strome (Canada Center for Remote Sensing, Ottawa). Session titles are "Planned Space Missions," "Microwave Sensors," "Requirements and Systems for Oceanographic and Atmospheric Applications," "Optical Sensors," "Ground Processing Systems," and "Requirements for Renewable Resources."
- Symposium on Microgravity Sciences and Processes, L.G. Napolitano (President, European Low Gravity Research Association, and Director of the Institute V. Nobile, Polytechnic of Naples, Italy). Session titles are "Experimental Results," "Theoretical Analysis," and "Microgravity Combustion."
- Symposium on Life Sciences, A.D. Egorov (Institute of Biomedical Problems, Moscow) and K.E. Klein (Institut für Flugmedizin, German Aerospace Research Establishment [DFVLR], Cologne). Session titles are "Life Support and Biomedical Monitoring Devices," "Space Biology and Medicine," and "Human Adaptation to the Space Environment."
- Symposium on Space Exploration, J. Casani (Jet Propulsion Laboratory, CA) and J. Riviere (Centre National d'Études Spatiales, Toulouse). Session titles are "Solar Systems Exploration," "Space Based Astronomy," and "Scientific Spacecraft (Spacelab)."
- 14th IAA International Symposium on Space Economics and Benefits, J.S. Greenberg (ECON Inc., Princeton, NJ) and J.A. Vandenkerckhove (ESA, Paris). Session titles are "Commercialization of Space Activities" and "Economics of Space Operations."
- 17th IAA International Symposium on Space Safety and Rescue, G.W. Heath (SAR-ASSIST Inc., Greenwich, CT). Session titles are "Space Safety and Rescue" and "Earth Safety and

Disaster/Distress Response Employing Space-Borne Systems."

- 13th IAA International Review Meeting on Communication With Extraterrestrial Intelligence, J. Bellingham (NASA Ames Research Center, CA) and R.K. Pesek (Czechoslovak Academy of Sciences, Prague).
- 18th IAA International Symposium on the History of Astronautics, F.I. Ordway (Alabama Space Rocket Center, Huntsville).
- Symposium on Space Energy, Power and Propulsion, J.J. Dordain (National Aerospace Research Office [ONERA], France) and J.P. Mullin (Space Energy Conversion, NASA Headquarters, Washington, DC). Session titles are "Space Energy and Power," "Chemical Propulsion Studies," "Chemical Development Engines," and "Non-chemical Propulsion."
- 1st IAA International Symposium on Global Habitability, G.G. McConnell (Assistant Associate Administrator for Space Science and Applications, NASA Headquarters, Washington, DC). Session titles are "Global Habitability: The Biosphere," and "Global Habitability: The Geosphere."
- 27th International Colloquium on the Law of Outer Space, I.H. Ph. Diedricks-Verschuur (Ed Baarn, The Netherlands). Session titles are "Space Law and Domestic Law," "Space Activities and Intellectual Property Including Industrial Property," "Nuclear Power Sources in Outer Space," and "Legal Aspects of Large Space Structures."
- IAA-IISL Scientific Legal Round-Table, M. Lachs (International Court of Justice, The Hague, The Netherlands).
- Astrodynamics, J.P. Marec (ONERA, France). Session titles are "Natural Trajectories," "Optimal Trajectories," "Attitude Motion," "Spacecraft Design and Technology," "Materials and Structures," "Benefits of Space for Education and Motivation for all Nations," "Positioning in Space and on the Earth," "The Influence of Space Development on the Humanities," "Fluid Dynamics of Planetary Atmospheres," and "Applications of Tether in Space."

Of the papers presented at the Congress, invited papers and a selection of survey and state-of-the-art papers will be published in a book on the proceedings. In addition, a selection of contributed papers will be published in special issues of *Acta Astronautica*, the archive journal of the IAA.

For further information on the Congress, contact the IAF Headquarters:

International Astronautical Federation
315 Rue Mario-Nikis
75738 Paris Cedex 15
FRANCE
Telephone: 33-1-567-4260
Telex: IAF 205917 F

R.L. Carovillano
5/17/84

MICROGRAVITY AND MATERIALS SYMPOSIUM ON SPACELAB-1 RESULTS

The Fifth European Symposium on Material Sciences Under Microgravity will be held from 5 through 7 November 1984 in Schloss Elman, Federal Republic of Germany. The conference site is a castle near Garmisch-Partenkirchen, which is about 100 km from Munich. The symposium will feature results from the successful shuttle flight of Spacelab-1. Experiments under microgravity conditions were performed on Spacelab-1 in fluid physics, crystal growth, metallurgy, physical chemistry, and other fields.

Contributions for the symposium are being solicited on the following topics: results of Spacelab-1 experiments in material sciences and fluid physics; laboratory microgravity experiments; other space experiments; and theoretical analyses. The scientific program committee will select papers for oral or poster presentation from submitted abstracts.

The abstract deadline is 1 September 1984. Communications should be sent to:

Prof. Dr. B. Feuerbacher
Institut für Raumsimulation
DFVLR
Postfach 906058
D-5000 Köln 90,
FRG

The microgravity program is sponsored by the German Aerospace Research Establishment, the European Space Agency (ESA), the European Low Gravity Research Association, and the German Ministry for Research (BMFT). Following the symposium, the BMFT will present a 2-day symposium (November 8 and 9) on the German microgravity program.

Proceedings of the conference will be published by ESA in a special publication.

R.L. Carovillano
5/17/84

BIOTECHNOLOGY IN IRELAND HIGHLIGHTED AT BIOTECH '84

Examples of commercially available products and services developed by Irish researchers, along with the considerable expertise available in Ireland, were highlighted at the Biotech '84 Conference held at the Wembley Center, London, in May. This was the first time that many of these researchers had marketed their services outside Ireland.

The Irish National Board for Science and Technology (NBST) acted as the agent for the researchers. NBST has worked closely with the Irish Development Authority (IDA) in building up the chemical, pharmaceutical, and health-care industries, and the two agencies are currently engaged in a joint biotechnology program. This program is designed to invest in biotechnology facilities and to improve the research base and range of services available to Irish industry. IDA, an autonomous state agency responsible for promoting industrialization, is committed to ensuring that these industries' rapid growth, which began in the seventies, will continue in the eighties. This is likely to be the case, as shown by the fact that a number of companies are expanding their facilities, and new companies are being attracted by the proven success of their competitors who have gone before them into Ireland.

There are three areas of priority in the program: animal and veterinary diagnostics, food and agriculture, and pharmaceuticals.

Since 1970, Ireland has become a major center for international business in Europe, with over 850 foreign companies establishing facilities there. The pharmaceutical and health-care industry has spearheaded the drive for new development, with 88 overseas companies now in production. Companies such as Merck, Johnson & Johnson, Smith Kline & French, Schering Plough, Eli Lilly, and Boehringer Ingelheim have helped boost the industry's exports from IRE25 million in 1970 to IRE675 million in 1982. This makes Ireland the 10th largest exporter of pharmaceutical products in the world. Seven of the

world's top 10 pharmaceutical companies and 15 of the top 20 US pharmaceutical companies now have plants in Ireland.

According to the NBST, there are several reasons why such international companies have located in Ireland: a maximum tax rate of 10 percent; nonrepayable cash grants; low-cost financing; training grants; a large, young, and highly skilled labor pool; and a favorable business attitude by the government. As a result of these incentives, Ireland is one of the most profitable locations in Europe for industrial investment. According to the US Department of Commerce, the average rate of return earned by US companies in Ireland is more than double that of other countries in the European Community.

Many of the chemical, pharmaceutical, and health-care industries in Ireland are, with the help of IDA, establishing research and development in conjunction with their manufacturing plants. These companies include Loc-tite, which developed its Super Glue in Ireland; Biocon Biochemicals, which has conducted extensive research into enzyme fermentation processes; Armour Pharmaceutical; Syntex; and Howmedica. IDA is taking a special interest in the developments in biotechnology and genetic engineering. With a strong biochemical tradition in the brewing and food industries, Ireland seems to be in a good position to take full advantage of the opportunities in this area.

IDA spends about 11 percent of the state's capital budget each year on assisting and promoting industry. It has a staff of 750 with headquarters in Dublin and overseas offices in 18 cities throughout the world: New York, Chicago, Los Angeles, San Francisco, Houston, Cleveland, Boston, Fort Lauderdale, London, Paris, Cologne, Stuttgart, Copenhagen, Amsterdam, Milan, Madrid, Tokyo, and Sydney.

Thomas C. Rozzell
5/15/84

INTERNATIONAL SCHOOL OF BIOPHYSICS INVITES APPLICATIONS

The International School of Biophysics will present its 13th course, Bioelectrochemistry II--Membrane Phenomena, in Erice-Trapani-Sicily, from 5 to 15 November 1984. Lectures, seminars, and roundtable discussions will address the following subjects and topic areas:

1. Structure and stability of membranes; their models; membrane lipids and proteins; breakdown and fusion.

2. Transport of charged species through membranes; thermodynamics; mediated, nonmediated, active and passive transport; coupling mechanisms.

3. Energy transduction; mitochondrial oxidative phosphorylation; chemiosmosis; photosynthesis.

4. Effect of electric signals on membranes; basic electrophysiology; thermodynamics of conformational states; electric modulation of tissue growth and repair.

The course will feature a distinguished group of lecturers from Europe, the Middle East, and North America. The directors are Dr. M. Blank (Columbia University, New York) and Prof. G. Milazzo (Rome, Italy). Those wishing to attend the course should write to:

Prof. G. Milazzo
Piazza G. Verdi, 9
00198 Rome
ITALY

They should specify: (1) date and place of birth and present nationality; (2) degree and other academic qualifications; (3) list of publications; and (4) present position and place of employment. In addition, a letter of recommendation should be included from their research group leader or from a professor of biochemistry, biophysics, electrochemistry, physics, physiology, or psychology. The committee of the school will select persons to attend the course. Only those so selected will be allowed to attend. The total fee, including full board and lodging, is \$500. Members of the Bioelectrochemical Society will be admitted for \$450, if approved by the committee.

The closing date for application is August 20. No special application form is required. A letter will be sent to successful applicants by September 15. Applicants who may have difficulties with travel documents or who need more time for approval, may get a special earlier decision by submitting a justified request.

Thomas C. Rozzell
5/15/84

INTERNATIONAL CONFERENCE ON UNDERWATER ACOUSTIC CALIBRATION AND MEASUREMENTS

The Underwater Acoustics Group of the Institute of Acoustics is planning a conference on underwater acoustic calibration and measurements for 13 and

14 December 1984 at Bracknell, England. All communications should be sent to Dr. L.W. Lipscombe, DBE Technology Group PLC, Eastern Road, Aldershot, Hants., England GU12 4TD (Telephone: 0252-27282; Telex: 85894 DBETEC G.). The conference proceedings will be published in book form, and copies will be available at the beginning of the conference.

Chester McKinney
5/23/84

GPO ANNOUNCES DEFENSE-RELATED PUBLICATIONS

The US Government Printing Office has several publications on science, technology, and defense.

The following publications may be ordered from the Superintendent of Documents, US Government Printing Office, Washington, DC 20402:

Department of the Navy RDT&E Management Guide; stock number: 008-040-00162-8; 288 pages; paper, \$6.00.

Principles of Naval Engineering; stock number: 008-047-00127-4; 668 pages; paper, \$13.00.

Ships, Aircraft, and Weapons of the US Navy; stock number: 008-047-00298-0; 60 pages; paper, \$4.25.

Understanding Soviet Naval Development; stock number: 008-047-00314-5; 156 pages; paper, \$7.50.

Naval Power in Soviet Policy; stock number: 008-070-00421-6; 356 pages; paper, \$7.50.

Military Psychology; stock number: 008-070-00353-8; 420 pages; paper, \$7.50.

Soviet Aerospace Handbook; stock number: 008-070-00402-0; 232 pages; paper, \$6.00.

Reference Manual for the ADA Programming Language; stock number: 008-000-00394-7; 344 pages; paper, \$8.00.

Computer on the Battlefield; stock number: 008-020-00954-7; 120 pages; paper, \$4.50.

Space Telescope; stock number: 033-000-00862-7; 64 pages; paper, \$5.50.

Also available is the catalog *US Government Books* (catalog number V-4). It lists almost 1000 government publications in categories such as computers and computer science, military, science and technology, and space exploration.

Larry E. Shaffer
5/11/84

ONRL STAFF CHANGE

In August we welcome Dr. Claire Zomzely-Neurath, Liaison Scientist for Biochemistry/Biophysics. She comes from Queen's Medical Center, Honolulu, Hawaii.

should write to the Scientific Director, ONRL, Box 39, FPO New York 09510.

Fatigue '84, Birmingham, UK, 3-7 September 1984.

International Conference on Digital Signal Processing, Florence, Italy, 4-8 September 1984.

Surface Modification of Metals by Ion Beams, University of Heidelberg, Federal Republic of Germany, 17-21 September 1984.

Ninth European Specialist Workshop on Active Microwave Semiconductor Devices, Veldhoven, Netherlands, 10-12 October 1984.

ONRL COSPONSORED CONFERENCES

ONR, London, can nominate two registration-free participants in the conferences it supports. Readers who are interested in attending a conference

MAY MAS BULLETINS

The following *Military Applications Summary (MAS) Bulletins* were published by the ONR, London, Military Applications Division during May. The *MAS Bulletin* is an account of naval developments in European research, development, test, and evaluation. Its distribution is limited to offices with the US Department of Defense. DoD organizations should request copies of the *Bulletins*, by number, from ONR, London.

<u>MASB Number</u>	<u>Title</u>
27-84	Fireguard THERMO-O--A New British Thin-Film Intumescent Fire-Protective Coating for Structural Steelwork
28-84	Polar Sheet Ice Modeling in The Netherlands
29-84	EDL 295b--A Rapid Charging System for Nickel-Cadmium Batteries
30-84	New Versions of the Trinational Tornado To Bolster European Air Defence--Part I
31-84	New Versions of the Trinational Tornado Bolster European Air Defence--Part II
32-84	Global Cloud Climatology
33-84	The European Centre for Medium-Range Weather Forecasts (ECMWF)

ONRL REPORT

To request the report, check the box on the self-addressed mailer and return it to ONR, London.

R-6-84: *Europe Approaches Chaos With Electrical Circuits*, by David Mosher. In this report, the underlying concepts for the period-doubling route to chaos are presented, and the scope of recent research in a variety of physical systems is briefly noted. Then, European research investigating chaotic behavior in nonlinear, driven electrical circuits is discussed in detail. These circuits--really nonlinear analog computers which solve the differential equations describing idealized physical systems--represent a bridge between the simple and highly abstract deterministic models and the experiments where complicating and competing effects can obscure the universal behavior.

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